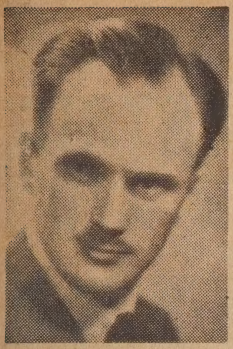
EDITORIAL



IN many ways the most interesting TV event of the month was the telecast of the Sydney Symphony Orchestra from the new studios of ABN.

Viewers were treated to a musical program, simultaneously broadcast from 2BL, and regaled with close-ups and odd angles of the players in action.

For those to whom such glimpses of the orchestra were new, no doubt the telecast was intensely interesting. The roving camera unearthed some quite surprising things about the players and their instruments.

But I for one find it hard to believe that the orchestra has a TV future. After the novelty of its appearance has worn off, there is very little to hold one's attention. The prime purpose of a concert is to present music. A long succession of prepared shots, which can only repeat themselves with little real variety, are surely an unjustified distraction.

Pictorially, sooner or later they become a dead loss.

Musicians are selected for their ability and skill in music—actors for their appearance and personality projection on the screen. With every good wish to our local musicians, they are not very good TV material, and, for that matter, very few orchestras are. Nor were they helped by a producer who seemed fascinated by a shot featuring the backs of their heads.

Only the sound offered any improvement over 2BL. Unfortunately, for all the acoustics of the new studio, this could not compare in any way with the sound of the Philharmonia which, at a turn of a switch, gave me the same program from an LP record.

Our orchestra playing in a concert hall is one thing. I fervently pray we shall always have it, for good or for bad.

But the same orchestra played through a sound system is inevitably a competitor against other combinations of better quality.

Doesn't this indicate that as time goes on our orchestras will have to justify themselves mainly on their public performances?

As broadcast or TV material, they only invite unfortunate comparisons.

The situation would be different if they could be lifted into world class, and their broadcast acoustics equal to those of the best recording studios.

But if not, what is their real future?

John Moyle

INDEX

TV Set Uses 10 inch Cabinet	3	All About Audio and Hi-Fi	57
Electronics Control Future Highways	4	Here's Your Answer Tom	62
Colour TV Must be Simplified	9	PortaGram—Radio & Records	64
Transistorized Mobile Radio	11	How To Get Your Amateur Licence	74
Radio Via Meteor Trials	13	Simple Course in Radio	76
TV Computer Flies Aircraft	15	Let's Buy An Argument	80
Weaving the Pattern of the Universe	16	Reader Built It	89
Technical Review	21	Trade Review & Releases	93
News and Views of the Month	29	A Course in Television—Part 28	96
Experimental Transistor Voltmeter	32	Off The Record	102
From the Serviceman Who Tells	43	Shortwave Notes	112
35 Watt P.A. Amplifier	48	The Ham Bands	113
		Answers To Correspondents	125

RADIO ★★ TELEVISION AND HOBBIES

A NATIONAL MAGAZINE OF RADIO, TELEVISION HOBBIES AND POPULAR SCIENCE

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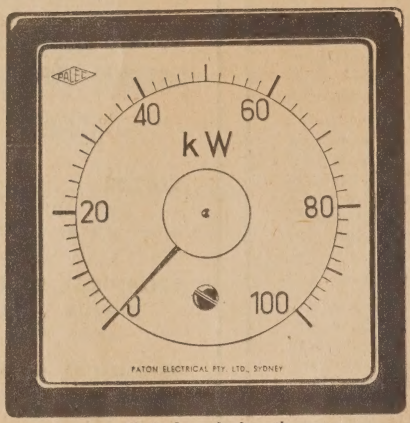
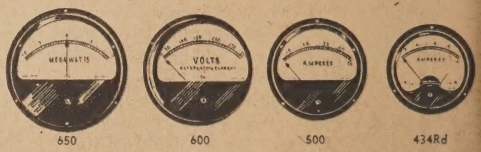
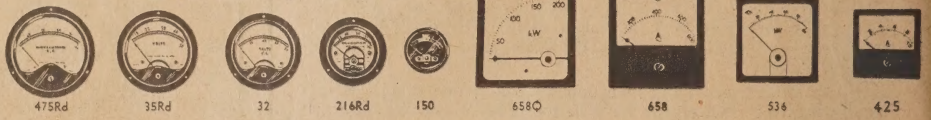
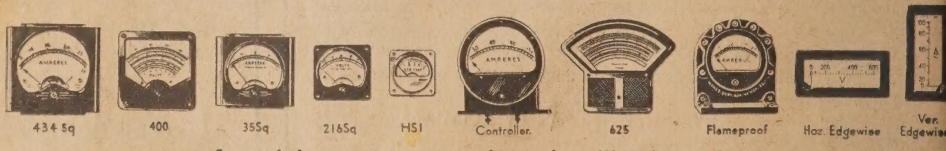


12 inch scale length







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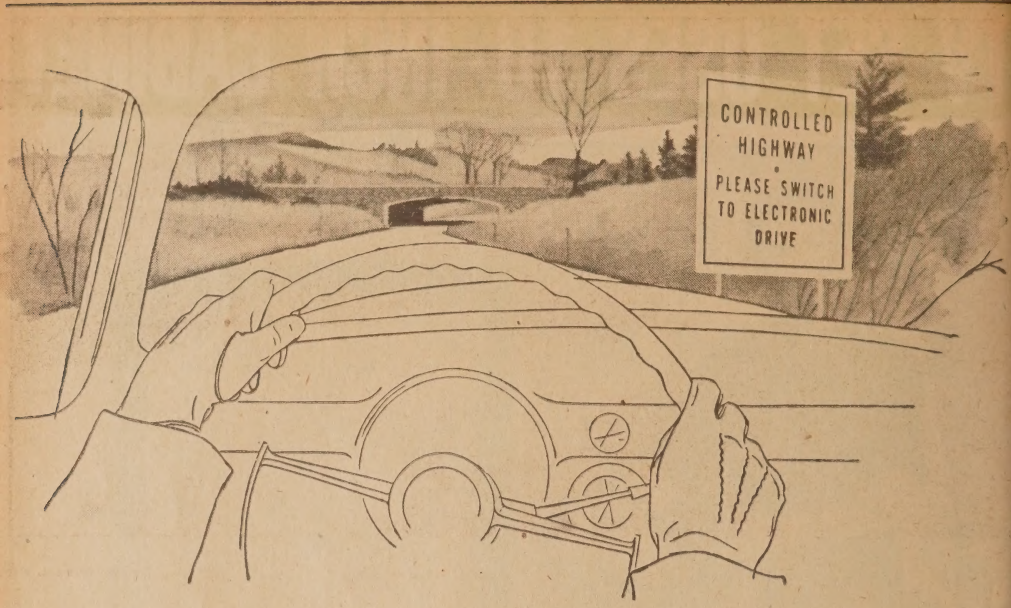
TV SET USES 10-INCH CABINET

The Sylvania Sylouette, a new American TV receiver claimed to be the slimmest ever made. It has concealed controls, high fidelity audio and a new, 110-degree tube.

The end of bulky TV cabinets is foreshadowed by this new 21-inch receiver made by Sylvania. It features a new tube with 110-degree deflection, and the cabinet which houses it is only 10 inches deep. The tube face projects a little beyond the cabinet as a "floating picture" The surrounding mask may be illuminated at three different intensities for easier viewing, and three speakers are mounted around the picture tube. The top section of the cabinet slides back to reveal the controls.



Electronics Control Future Highways

How are we going to solve the problems of road traffic as the pressure upon them grows so much greater each year? How many accidents are due to the human element, lack of judgment, or poor visibility? Why shouldn't we learn a lesson from other forms of transport such as the railways, and airlines, where automatic equipment is rapidly taking over.

PASSING the above sign as you enter the superhighway you reach over to your dashboard and push the button marked "Electronic Drive." Selecting your lane, you settle back to enjoy the ride as your car adjusts itself to the prescribed speed. You may prefer to read or carry on a conversation with your passengers—or even to catch up on your office work. It makes no difference for the next several hundred miles as far as the driving is concerned.

Fantastic? Not at all. The first long step toward this automatic highway of the future was successfully illustrated in recent months on a 400-foot strip of public highway on the outskirts of Lincoln.

Both unequipped vehicles and a test car with special receiving equipment were used to show the immediate uses and the ultimate possibilities of electronic highway control.

ROAD LIGHTS

Coupled to a series of experimental detector circuits buried in the pavement were a series of lights along the edge of the road. In the test car were special radio receivers and audible and visual warning devices to simulate automatic steering and brake controls.

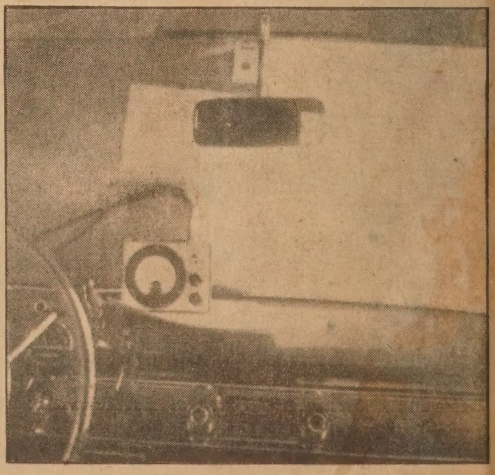
In a series of tests, the installation at Lincoln proved its ability to;

- Provide automatic warning to a driver following too closely behind another vehicle.
- Indicate to a driver the presence of a parked vehicle or other obstacle in the highway ahead.
- Guide a car accurately along its traffic lane even under conditions of zero visibility for the driver.
- Cause remote operation of warning lights ahead at points of merging traffic, or along the roadside for any distance ahead of or behind a moving vehicle unequipped with special equipment.

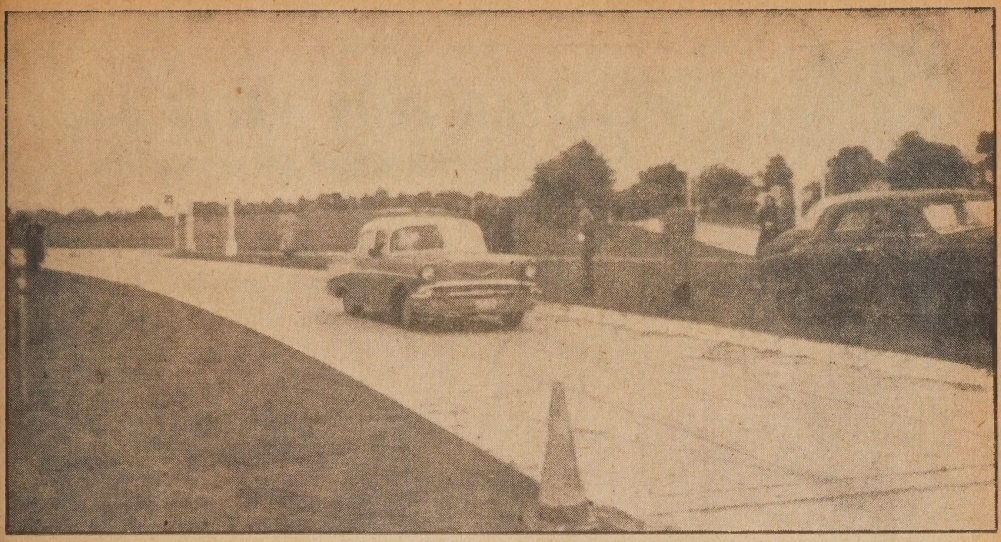
The demonstration, observed by nearly 100 highway officials, representatives of automobile manufacturers, and the press, made two major points.

First was the fact that the various elements of the system can be used immediately in conjunction with arrays of roadside and intersection lights to increase driving safety under present conditions, without requiring special equipment on cars or trucks.

Second was the clear indication that the system as a whole can be developed without major technical complicat-



Warning devices include left-right indicator (below rear-view mirror) and buzzer and warning lights for obstacles such as other vehicles or maintenance crews.



Cars with radio receivers run tests on highway equipped with buried detector circuits at Lincoln, Nebraska. Efforts to date are experimental.

ions into a fully automatic highway traffic control system.

Operating the system of the future will be as simple as it seems fantastic. From beneath the pavement, electrical signals will radiate from buried wires to be picked up by the tiny transistorised receivers built into the car.

On one frequency will come the signals from the guidance cable, controlling the power steering mechanism to keep the car in its lane.

AUTOMATIC CONTROLS

Signals on another frequency will warn of obstructions in the highway half-a-mile or a mile ahead—perhaps a stalled vehicle, or a highway maintenance crew at work.

Whatever the cause, signals, picked up by another receiver in the car, will operate automatic controls that reduce your speed by letting up the accelerator, apply the power brakes, or guide the car automatically into the next lane to pass the obstruction.

Operating on a third frequency, the special highway receiver on the dashboard will pick up signals from a buried antenna and cut off the standard car radio to make an announcement of its own: "Exit Number Three for Pittsburgh area is five miles ahead. Connections at this exit with Routes 19 and 28. Please watch roadside signs for further directions."

Approaching the exit the radio will again cut in with an announcement supplementing the roadside signs. "Exit Number Three for Pittsburgh area is two miles ahead. Motorist for Exit Three please switch off electronic drive and move to exit lane at extreme right." The motorist will simply push a button to switch the car to manual control. He will then move into the right lane to approach the exit and turn off the superhighway.

EARLY REQUIREMENTS

Behind the Lincoln demonstration, and the further developments that are likely to come from it, is a story of imagination and enterprise.

Experiments with traffic control were made as far back as 1953 using a pattern of wires on a laboratory floor which was used to guide a miniature car.

Soon, engineers decided to experiment with the idea in an actual highway installation.

The opportunity that presented itself was the construction of a new main intersection of U.S. Route 77 and Nebraska Highway 2 on the outskirts of Lincoln. As the pavement was laid, the necessary wiring was buried, preparing the ground for the experimental work.

What the observers saw at the first public demonstration was a system comprising three basic elements:

(1) A sequence of detectors installed at intervals slightly greater than car length along the road, capable of reacting to the passage of cars;

(2) A radio warning system for following vehicles controlled by a signal from the detectors;

(3) A guidance system to keep each vehicle centred in its lane.

The detectors consist of rectangular loops of wire, six by twenty feet, buried in the pavement in the traffic lane, and coupled to an associated circuit at the edge of the road.

The loop carries a voltage from the high-frequency power line. When a vehicle passes over the loop, the result is a variation in current which is detected by the roadside circuit.

The circuit then produces an output signal that controls an indicating device such as a warning light, and at the same time switches on the radio warning system for following vehicles.

The radio warning system is simply a transistor switch and an antenna that extends back beneath the pavement from each of the detector loops for any desired length. When the detector responds to a passing vehicle, the transistor switch is closed, causing the antenna to radiate a signal.

TAIL WARNING

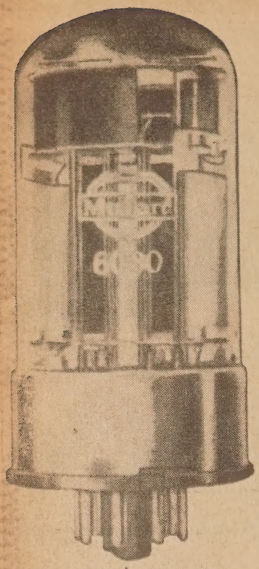
This continues for a certain interval of time after the vehicle has passed, so that the antenna radiates, in effect, a tail warning behind cars as they move along the highway. The tail warning signals can be used to actuate warning lights along the side of the road or they may be picked up by following cars with appropriately tuned receivers that can be used ultimately to activate automatic control of brakes.

The guidance system is a cable laid down the centre of the traffic lane beneath the pavement, carrying a signal current of yet another radio frequency. To use the continuous signal, a car is equipped with small receiving antennas mounted at either end of the front bumper or on both front fenders. These antennas are connected to a differential receiver which responds when it receives two signals of differing intensities.

As long as the car is centred over the cable, nothing happens. As soon as the vehicle moves to either side, one signal increases in intensity while the other decreases, causing a response in the receiver. In the demonstration, the effect was shown on a meter in the test car; in the ultimate system it would be used for automatic control of steering mechanism.

Perhaps the most telling point of the demonstration in the eyes of highway experts was the extent to which the electronic system is compatible with present highway conditions having many applications in the near future without requiring any equipment in cars.

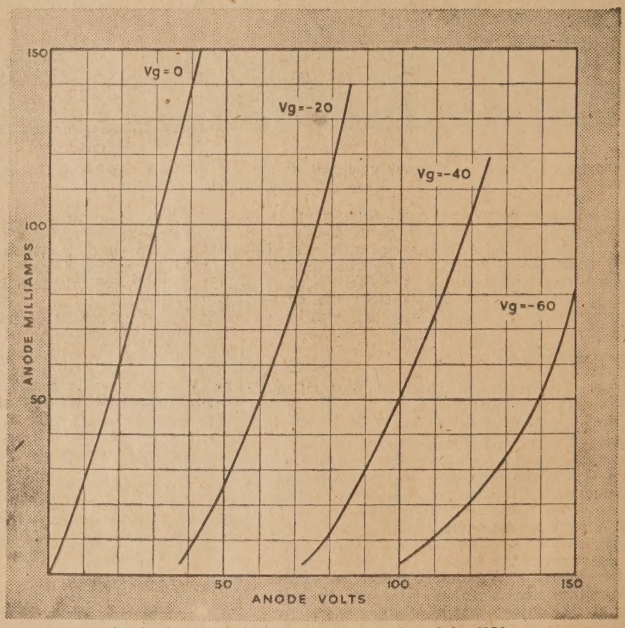
The point was demonstrated simply. As cars entered the test strip a warning light automatically flashed on over a merging traffic sign 400ft ahead, alerting drivers approaching



SERIES REGULATOR VALVE 6080

a new double triode with REALLY low impedance

A quick reference to the anode characteristics of the 6080 reveals its unusually low impedance and the very small voltage drop produced across each of its triode sections. These are the factors that are making the 6080 indispensable in the design of more efficient series regulation and servo control systems.



Anode characteristics of each triode section of the 6080.

6080 (CV2984) Double triode with separate cathodes

V_h: 6.3 volts. I_h: 2.5 amps Base: Octal.

Abridged date for each triode section

$V_a$max. 250 volts	g_m 7.0 ,A/V	$I_a$max. 125 milliamps
μ 2.0	r_a 280 ohms	$p_a$max. 13 watts

The 6080 is the modern version of the 6AS7-G and is available from Mullard to the American MIL-E-I Specification.

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along an adjacent road. Then, as each car moved over the buried loops, a light beside each loop was turned on automatically, tracing the passage of the car through the test area.

The use of lights along the roadside could provide a visual substitute for the radio tail warning, serving vehicles without any receiving equipment. In this way, a vehicle moving along in the fog might light a series of lights several hundreds of feet behind it, warning approaching cars and immediately preventing rear-end collisions in fog banks —a type of accident that has involved as many as 30 cars at one time on the New Jersey Turnpike.

It is necessary to consider how such a system could be introduced gradually as the task of installation in its fully developed state might pose many problems. It is quite practicable to proceed in stages something along these lines:-

(1) No auxiliary equipment in vehicles, but systems of warning lights activated by the buried detector units. This could be done immediately perhaps beginning with isolated sections of the highway system.

(2) Some cars equipped with signal detectors which would give the driver a dashboard indication of the distance of the clear roadway ahead, even under conditions of zero visibility.

(3) Automatic vehicle control introduced on a step-by-step basis, beginning with installed equipment that would make use of signals from the guidance cable and buried antenna systems to control steering and braking.

ROUTE CHANGES

Ultimately, automatic devices would sense suitable opportunities for passing, and would change routes in response to a program pre-set on an electronic computor in the vehicle. The driver would have to take over only as he left the high-speed road system.

There is nothing at all fanciful about the idea of road control. In the sky, airliners have been forced to adopt very similar systems of automatic guidance, although, by its very nature, air travel finds it difficult to assume systems good enough to land aircraft with sufficient accuracy and consistency.

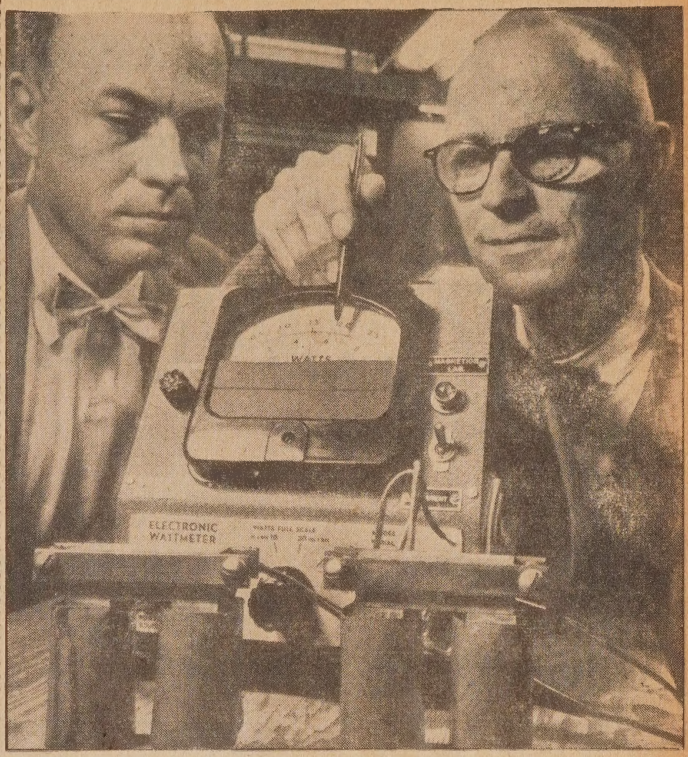
Road travel is rapidly approaching the point where some such control might be the only answer to repeated accidents and gradual immobilisation of traffic. By the retention of the human element and our inability to co-ordinate it when large numbers of units are concerned, many roads could eventually become too dangerous or too congested to use at all.

If we are to anticipate conditions which may be forced upon us in years ahead, we must begin now to develop the solutions to future problems, and gain some experience in their application.

IT is believed that about one-third of the present-day users of hearing aids have the kind of defect that could be helped by a sound spacer. The difficulty of words running together becomes more common with advancing age, especially in regard to women's voices.

To help these people a revolutionary type of hearing aid that not only amplifies speech sounds but also slows down their speed has been perfected in the laboratory if the Johns Hopkins Hearing and Speech Centre, in Baltimore.

CUBE ORIENTATION CUTS LOSS



Engineers at G.E. indicate how losses are reduced in the new iron used in identical transformers. Meter reads losses in the new iron, pen indicates reading given with ordinary grain oriented iron.

Cube-oriented magnetic steel is now in pilot-plant production. It is expected to find its first applications shortly in airborne transformers, relays and other electronic components.

WESTINGHOUSE has carried process development to the production of thin strips and is making thick gauges under laboratory conditions.

Known as Cubex, it is three per cent silicon-iron steel which has cubic crystals. Its crystals line up like ice cubes in a refrigerator tray. Since magnetic flux travels easily along cube edges, the new steel permits flux across the width of the strip as well as along the length.

Grain-oriented silicon-steel used for 25 years as a core material lines up the cubes on one edge. Resistance to flux diagonally through the crystals limits flux to the direction along the length of the strip.

Tests comparing the magnetic efficiency of the two types of silicon-steel show the new steel has greater magnetic strength, less resistance to alternating flux and lower hysteresis loss. One-half oersted coercive magnetic force will produce a 2,500-gauss induction in grain-oriented steel and almost 10,000 gauss in cube-oriented steel while loss at 60 cycles and 13,000 gauss is cut, 0.7 to 0.5 watt.

The new steel can also result in simplified production techniques. Cores of grain-oriented silicon-steel are commonly made in two or more parts to allow flux to follow the grain. Cube orientation allows one-piece construction since the lines of force can turn corners within the same piece of steel.

General Electric has also announced the development of "four square" silicon iron, for which similar advantages are claimed.

It is claimed that costs will eventually work out at the same level as ordinary iron although further development is needed before laboratory results can be duplicated in practice.

Processing steps for "four - square" iron follow the same general pattern as used in making singly oriented materials. At the metals and ceramics building these steps begin by melting the raw material in a standard furnace. Subsequent rolling and heat-treating of the cast ingots produces long sheets of material approximately 12in wide and in any desired thickness for use in the laminated cores of large transformers, motors and generators.

PHILIPS self-contained Wavemeter

GM 3121

Range: 2.5, 560 M.C.

Accuracy: Better than 2%.

Indication: Visual Neon or 'phones.

APPLICATIONS

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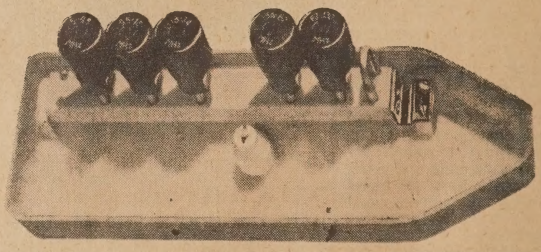
- Determination of resonant frequency of circuit.
- Measurement of inductance.
- Measurement of capacitance.
- Tuning of HF circuit.
- Frequency measurement of antennæ.
- Neutralisation and others.



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Type GM 2893: 90 Kc/s—50 Mc/s

This unit has the extended range 25 Mc/s to 50 Mc/s to cover TV I.F. spot alignment.

Type GM 2883: 90 Kc/s—30 Mc/s

Incorporating: Turret band changing metered output. 270° illuminated scale expanded I.F. range 400 Kc/s-500 Kc/s.

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B.B.C. ENGINEER SAYS COLOUR TV MUST BE SIMPLIFIED

In a recent broadcast from the B.B.C. Home Service, Sir Harold Bishop, Director of Engineering, told listeners of the aims of the B.B.C. experiments in colour TV which are now being carried out. The B.B.C. was hoping for many improvements in present techniques before adopting any system for its use.

THREE aims were in view, he said.

"The first is to get further knowledge of compatibility using the adapted American NTSC system.

"The second is to get experience in the operation of a colour studio and colour television equipment. The third is to provide high-grade television picture signals so that the radio industry can develop colour receivers.

"Of course these three objectives are closely related," said Sir Harold, "our results so far are encouraging and seem to show that the NTSC system has great possibilities, but that a lot has still to be done to develop terminal apparatus both at the transmitting and at the receiving ends.

MUST BE SIMPLER

"In the studio, the colour camera must be simplified and made more reliable and easier to set up and operate. We hope, for example, that, in due course, a single picture-tube will do the job of the three now used.

"At the receiving end, at present we are dependent upon one make of display tube to reproduce the colour picture.

"This tube, developed by the Radio Corporation of America, is a fine example of engineering skill, but it is expensive to make and one would expect that further development will lead to simplification, lower cost, and improved quality.

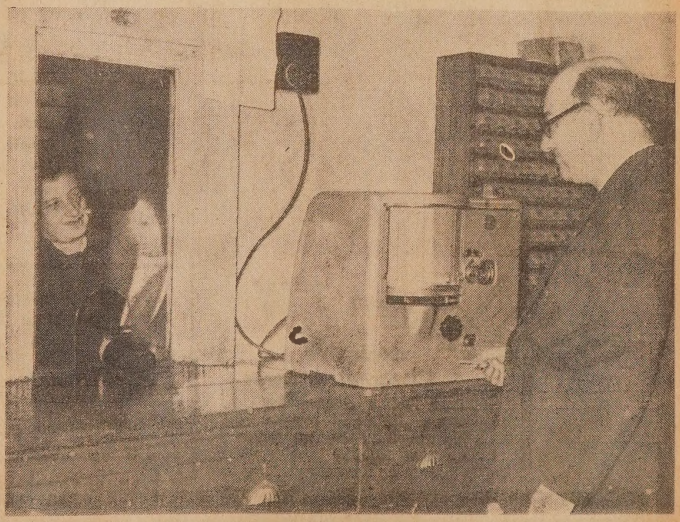
TOO MANY VALVES

"There are about forty-two valves in the present experimental colour receiving sets compared with some twenty in a black-and-white set. There must obviously be some simplification here to cut cost, and improve reliability.

"Perhaps we can look forward to a colour projection tube giving a picture on the wall of the living room comparable in size and quality to the best type of home cine projectors which are now so popular."

SOLDIER ENDURES STRANGE TEST

This soldier is undergoing a strange test at the Farnborough Clothing and Stores Establishment in England. In the Applied Psychology section, human responses to vibration are tested by bouncing the subject from .006 to .5 inches at selected frequencies. The results are expected to aid in the design of vehicles and aircraft.

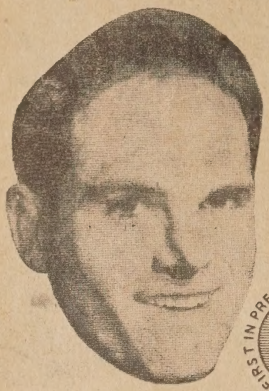


German designed machine being tested in England prints all necessary details on a railway ticket, records all transactions, and slashes accounting duties. Known as the Flexiprinter, it will be installed at railway stations if tests are successful.

CHANNEL MASTER

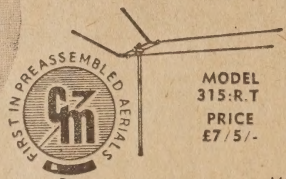
The world's largest range of TV Aerials —

Backed by the finest technical skill of America and Australia



"CITY VEE"

gives a superior gain and directivity in a vee - type aerial



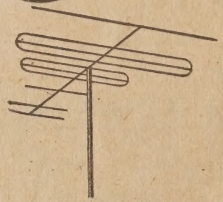
MODEL 315:R.T
PRICE £7/5/-

This low priced aerial is proving tremendously popular. It gives excellent results in metropoitan areas covering Channel 1 through 10. People like it because it looks attractive and modern.

MODEL 310

Dual flector

Ideal for strong to medium signal areas. Makes an excellent loft aerial. Covers Channels 1 through 10.



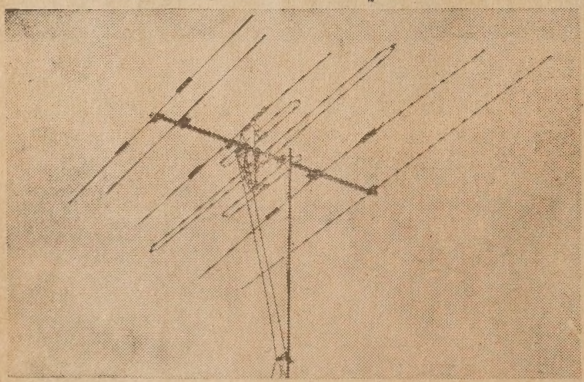
MODELS 626 - 1026

CHALLENGER

6 and 10 element composite Yagis for areas where high gain and directivity is needed. Low priced to meet and beat all competition. Cover all channels in use.

SHOWMAN

An indoor aerial masterpiece. Has fashion appeal as well as greater power than any other indoor aerial. Perfect for flats, etc., where outdoor aerials are banned



THE MIGHTY RAINBOW!

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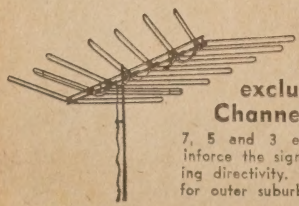

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PLASTIC ANTENNA SYSTEMS USED FOR SCATTER SYSTEM

Advances in the scatter technique for radio communication are instanced by the development for the U.S. Army of a transportable system using portable plastic antenna systems which are inflated and mounted on operating huts.

THE scatter system employs ultra-high frequencies which are transmitted at high power towards the receiving point, and travel well beyond optical horizon by the scatter effect in the troposphere.

Only a small proportion of the radiated power arrives at the receiving aerial, but results show a comparatively steady signal strength over distances which have reached over 1,000 miles.

High gain aerial arrays are required for this type of transmission, and at these frequencies parabolas are invariably used.

The air-inflated antenna is easy to erect — inflates in 12 minutes.

This equipment, now being tested, employs light-weight 15ft air-inflated plastic antenna reflectors.

The plastic material is clamped to a hoop assembly, and sealed to provide air-tight parabolic-shaped surfaces when inflated.

Inside the surface of the rear section is a coating of aluminium to serve as a reflector of radio energy which emerges from a feed horn mounted in front. Its construction resembles another type of antenna known as the Paraballon radar antenna which functions on a similar principle.

The system operates in the 1,000 Mc band, and provides a multi-channel service over distance of 50-100 miles.

About 12 minutes are required to inflate the antenna-reflector by means of a motor-driven blower. The air pressure is maintained by the blower which comes into action automatically should the pressure fall below a certain level.

The antenna is robust, and is designed to withstand wind velocities of 70 mph. It has already withstood 50 mph gales during tests.

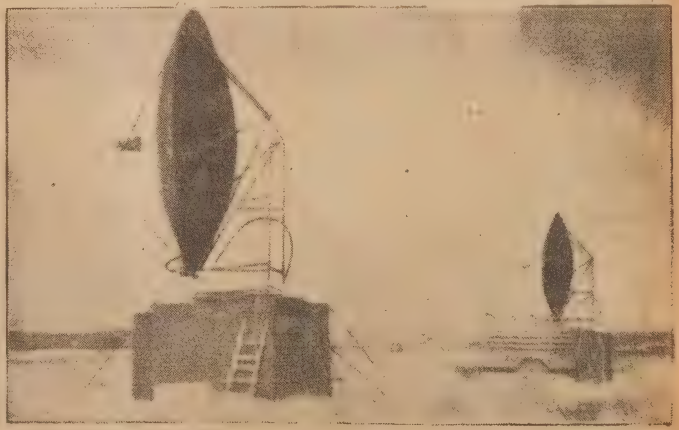
The complete antenna, including its tower, weighs 400 lbs which is nearly 1,000 lbs lighter than its conventional equivalent. It is erected in a short space of time, and is adjustable to allow the reflector to shift its aiming point over a range of plus or minus 3 degrees in elevation, and plus or minus 5 degrees in azumith.

The antenna is excited with a feed horn of the open ended waveguide type, and achieves a standing wave ratio of less than 1.3-1 over the 755-985 Mc range. This eliminates the need for an antenna tuner.

The reflector has a focal length of 6ft and the feed provides a 10 db illumination taper with approximately 29 db gain relative to an isotropic antenna.

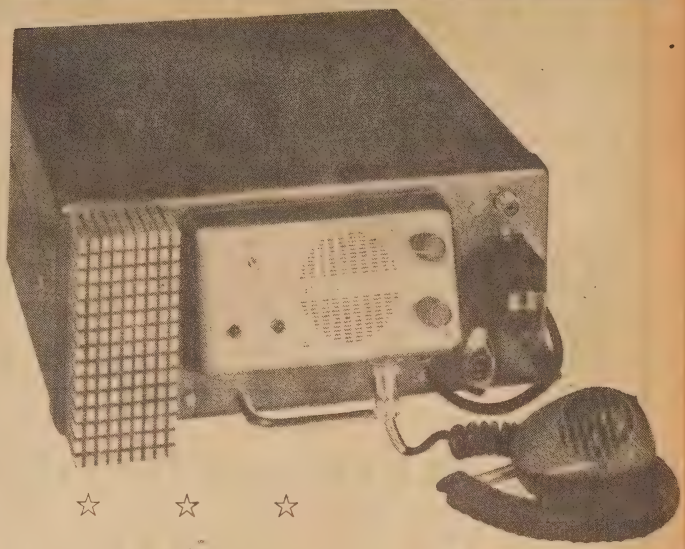
The entire equipment can be packed into two metal huts which may be carried in C-119 or C-124 transports, and which serve as shelters when it is installed.

Two antennas are used at each terminal to give space-diversity operation.



The tropospheric scatter communication system uses dual air-inflated antennas for space-diversity operation.

TRANSISTORIZED MOBILE RADIO



Transistors are now being used for powering mobile communication equipment, easing the problems of manufacturing high output units and eliminating the hash originating in vibrator power supplies. The transistor unit in this equipment is behind the grill on the front panel which contains a heat sink for fast heat dissipation and maximum protection. Battery variation from plus 20 per cent to minus 50 per cent will not cause damage. These equipments are offered at 30 and 60 watts (25-54 Mc), 25 and 50 watts (144-174 Mc), and 15 watts (450-470 Mc).

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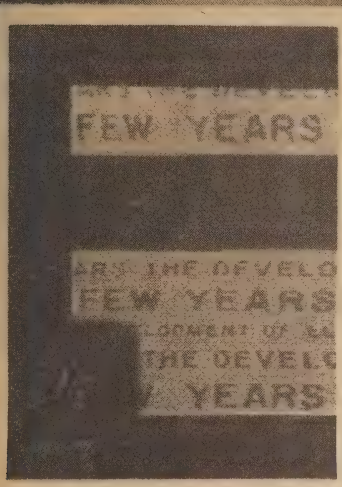
Radio Via Meteor Trails



Ionised meteor trails lasting but a few seconds, are proving new means of transmitting high-frequency radio signals over long distance without the use of relays.

ELECTRONIC SCIENCE, one of the virtues of which is a remarkable ability to make orderly use of random effects, is turning to one of nature's most haphazard phenomena to achieve a new technique of radio communication.

The phenomenon is the apparently aimless but heavy bombardment of meteors penetrating the upper atmosphere 60 to 100 miles above the earth. The new technique is the bouncing of radio signals from trails of ionized air that linger briefly behind the plunging meteors before they are destroyed by friction.

Scientists, studying meteor path propagation of radio signals have recently employed meteor trails for the first time to transmit images of printed material over a distance of nearly 1,000 miles without relays. By means of experimental facsimile equipment developed at RCA Laboratories, high-frequency signals carrying the visual information have been bounced via meteor trail from the transmitting station of the National Bureau of Standards at Havana, Illinois, to Riverhead, Long Island—an airline distance of 910 miles.

CONTINUOUS TRANSMISSION

At the Riverhead receiver, the transmitted images have flashed briefly on the viewing screen as frequently as several times each minute during test transmissions, to be recorded each time by a camera built into the special receiving system. Each appearance of an image has signified the appearance along the transmission path of a meteor trail sufficiently long and persistent to reflect the signals downward toward the directive receiving antenna at Riverhead.

The scientists' explanation of the events involved in the system runs this way.

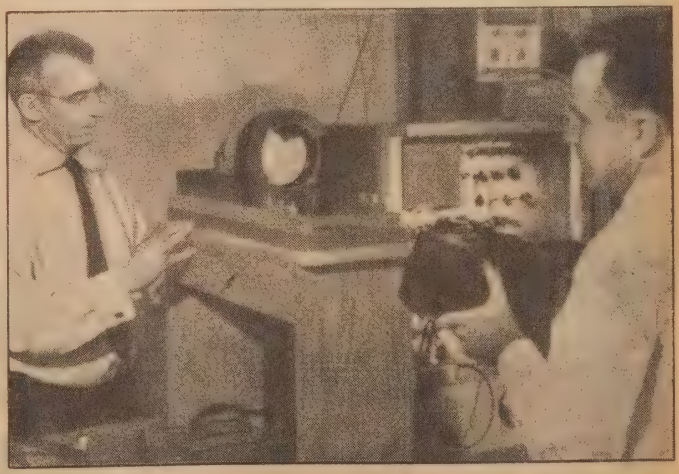
When a meteor enters the upper atmosphere, its high velocity causes the air particles to break down into positive and negative ions. This trail of ionized air, which may persist for periods from one-tenth of a second up to several minutes after passage of the meteor, acts as a reflector of radio signals that would otherwise radiate out into space.

Meteors come in many sizes, leaving trails of varying lengths and persistence. The frequency with which useful trails may appear along any given transmission path is related to the amount of power employed for transmission and the bandwidth of the signal. Along the Havana-Riverhead path, employing a video bandwidth of 106 kilocycles, such trails may materialise from one to several times per minute to close the circuit.

The experimental system transmits continuously, sending copies of a picture over and over at the rate of two complete scans each second. The receiver is also operated continuously, with the recording unit in a standby condition. When a passing meteor closes the transmission path, the incoming signal trips the recorder to permit reproduction of the image on the phosphor screen, where it is photographed automatically. The circuit then resets automatically for the next burst.

Basic research in the field of meteor trails has been conducted mainly under sponsorship of the Department of De-

(Continued on page 15)



At the RCA receiving facilities at Riverhead, L.I., images from meteor trail transmissions flash briefly on a viewing screen; they are recorded by a fixed camera.

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Sydney to Melbourne in two minutes: this example of the speed of the earth satellite probably means more to us than stating the velocity as 18,000 miles per hour.
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NEW TYPE DISPLAY NEEDS FEWER INSTRUMENTS

Constant efforts are being made to simplify the task of aircraft pilots, in the interests of both efficiency and safety. Stress is laid on presenting the pilot with information with less dependence on ground staff.

TEST results indicate that TV-like flight data presentation will develop into a huge military and civilian business within a decade.

The impact on the electronics industry will be felt as an increasing demand for transistors (for use in computers), flat-screen crt's, and more special-purpose analog and digital computers.

Out from under the cloak of classification and now in public view is the new instrument panel called ANIP (Army-Navy Instrumentation Program).

Present design uses a special-purpose, high-speed electronic digital computer to transform input data from conventional sensing devices into signals which generate pictures on two flat-screen, transparent cathode ray tubes.

The display enables the pilot to determine his ground track and aircraft altitudes as if he were looking out his cockpit on a clear day.

The U.S. Navy estimates that the system will be operational in its aircraft by 1959 or 1960. The Army intends to use a modified version in helicopters.

SIMPLE AND ACCURATE

Commercial airlines are also favourably impressed by the possibilities of the system.

At the present time the probable costs are not known.

Proof of the simplicity and accuracy of the entirely different instrumentation concept was furnished recently. A non-pilot successfully flew a Navy T2V-1 jet trainer without once seeing beyond the cockpit.

Responsibility for development of the Navy system (see photo) rests with the El Segundo division of Douglas Aircraft.

One of the crt's in the prototype provides a two-dimensional picture arranged to give a three-dimensional perspective to terrain and sky which has been designated by the new term "contact analog".

The other presents a navigational-type map display. A Kaiser-Aiken crt is used which is 2-5/8 inches thick, 20 wide, and 11 high.

Signals for both contact analog and map display are provided by an electronic digital computer designed and built by Litton Industries. Smaller than a bread box and weighing only 40 pounds, the computer is capable of processing sensor data at the rate of 15,000 computations a second.

NAVY VERSION

Program responsibility for the Army helicopter phase has been assumed by Bell Helicopter. Since the pictorial presentation of flight data for rotary wing aircraft presents different problems, a modified version of the Navy's program is used.

This system, instead of using a digital computer, employs a special-purpose analog contact generator designed and built by DuMont. Six general equations describing relationships between flight data parameters are continuously solved by analog computers contained in the generator. The results are displayed on either a conventional or flat-screen crt.

At the moment, the Army system is being tested on a Bell-designed dynamic flight simulator.

Cmdr. G. W. Hoover, manager of the ANIP project, believes the instrument will eliminate 50 percent of plane accidents now costing taxpayers about one million pounds per day.

TV COMPUTER FLIES AIRCRAFT

Aircraft cockpit shows a minimum of dials — flying information is co-ordinated into new display. Note the table map — actually a TV type tube only 3 inches thick.

MAGNETIC FIELDS DO EXIST BETWEEN PLANETS

RECENT studies now available prove that magnetic fields exist in the space between planets, and that some cosmic rays do come from the sun. Solar outbursts, such as that of February 23, 1956, release in 20 minutes the energy of a billion of the largest known hydrogen bombs.

This energy is partly in the form of nuclear particles travelling at close to the speed of light. Ranging in energy from one to 40 billion electron volts, these particles are stored for as long as 15 hours in extensive, but weak, magnetic fields occupying a large portion of interplanetary space.

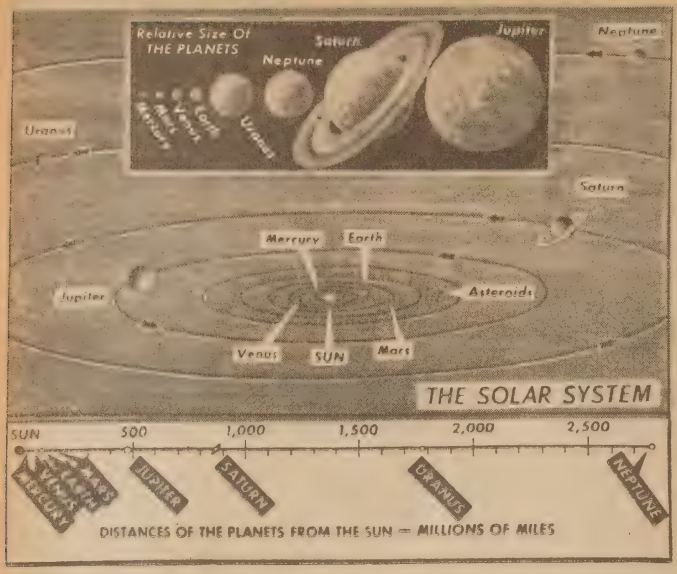
Measurements taken at various university stations throughout the world and during balloon flights show that these huge fields act as a leaky bucket. Within minutes after a large flare, the intensity of cosmic radiation to outside of the solar system is high. As the field "empties," the leak lessens. After many hours just a "trickle" of cosmic rays are shooting away to other parts of the universe.

Radio via Meteor Trails

(Continued from Page 13)

fence, at Stanford University, the National Bureau of Standards and other facilities in the United States. In addition, similar work has been done in Canada and England, including the development by the Canadian Research Board of a teletype system employing this technique.

Specialists have indicated that meteor path propagation promises ultimately to increase the versatility of radio communications by providing a means of sending information at times and over distances for which other means may not be available. According to report, the optimum distance for transmission by this means is 600 to 1,200 miles.



This diagram gives a quick picture of the solar system. The top section shows the relative sizes of the planets from Mercury to Jupiter. The centre section illustrates the path of the planets' rotation around the sun. Asteroids or tiny planets are located arbitrarily in the centre part of the drawing—individually they wander in endless eccentric orbits. The bottom section shows the comparative distances of the planets from the sun. Pluto cannot be shown—it is more than 3½-billion miles away.

Weaving the Pattern of the Universe

The problem of the origin of the universe, and of the earth and moon in particular, is one which has engaged the attention of scientists for many centuries. Even today there are sharp divisions of opinion among the world's leading authorities.

by Calvin Walters

SCIENCE and religion seem to be somewhat at variance on this point, with science on the one hand seeking to find in ages past some violent catastrophe in space which split up some vast amount of matter into the stars, planets and other bodies now existing.

Religion, on the other hand, has a simpler explanation in that the world was created just as it is and that's that.

VIEW OF SCIENCE

Science finds such a theory far too simple in that its universal acceptance would mean almost the end of further inquiry. All we would need to do would be to sit back and see what happens next.

Religion seems to imply that whatever happens is planned and we can do nothing about it, anyway, so why worry.

Science says that it does not deny the existence of God, but that He did not create what we see today. What He did was to create matter and then devise certain laws which set in motion a train of events which, by a process of evolution, resulted in the universe as we see it today, together with all living things in it.

That, then, in perhaps an over-simplified form, is the situation between the two lines of thought.

We know that violent cataclysms do occur in outer space, for astronomers have actually witnessed the explosion of a star. But as the light from these explosions has just reached us after a journey of thousands of years, science can claim with some justice that what we see is creation taking place. They assume that the quieter and settled parts of the universe "happened" in the same way many thousands of years before.

One theory which held some popularity about 150 years ago was that propounded by the French scientist Laplace. This was the nebula theory of creation which stated that the sun disintegrated and formed a rotating spiral of hot vapour in the form of the well-known nebula which is a common sight in parts of the Milky Way.

EFFECT OF COOLING

As the mass cooled somewhat it contracted to a point where, with an increase of its rotational speed, it threw off gaseous matter which collected in rings like those now seen around the planet Saturn. These rings finally condensed and formed the planets as we now know them.

This theory has fallen into disfavour because scientists cannot reconcile the fact that, while the planets are so much smaller than the sun, they have many, many times the energy of rotation of that star.

Other scientists like Sir James Jeans suggest that a star of tremendous proportions came close to the sun and, by virtue of its tremendous gravitational pull, tore away large quantities of gaseous matter from the sun. This matter subsequently condensed into the planets.

Others say that perhaps the sun collided with another star or that the sun by its gravitational pull caused dust particles to collect into denser matter, which broke up into pieces. These pieces in turn collected other particles until they grew into the planets.

How the planets and the universe were formed is a matter which therefore has never been settled and no doubt will be a subject for debate and research for many more years to come.

In view of the current experiments with space rockets and conjectures relating to travel to the moon, a more topical subject and one which holds a great amount of interest is that relating to the origin of the moon.

This has a direct relationship to the question of when the earth cooled off from its liquid state and became a solid, for as we shall show later there is good reason to believe that the moon is matter torn from the earth millions of years ago.

TORN FROM EARTH

If it can be shown, then, just when the earth assumed a solid state it will follow that the moon "evolved" sometime prior to this, for the latter could not be torn from the solid earth.

For if it had the moon would not exhibit the perfect spherical shape it now has. It would be simply a shapeless mass of rock and earth. There would also be

CAMERA RECORDS OF A VAST, ANCIENT EXPLOSION

Left—A picture of the Spiral Galaxy NCG 5668 taken with the Schmidt Palomar 48-inch telescope in 1952—no stars are visible in the Galaxy. Right—Another picture taken in May 1954 after a huge explosion which produced a supernova. This explosion took place 20-million years ago, and its light has taken all this time to reach us.

a hole in the earth somewhere exactly corresponding to the shape of the moon.

It therefore follows that the earth must have been at least in a plastic state with a semi-solid crust at the time the moon was parted from it.

Modern science uses a very cunning method to determine the time when the earth assumed its solid state. They use the knowledge about the rate of radiation of radioactive substances such as uranium.

URANIUM RAYS

Among the radiations emanating from uranium are alpha particles, beta particles, gamma rays, and so forth. Alpha particles are the nuclei of helium atoms, which have a positive charge.

From the known rate at which these particles are given off it has been calculated that in 4,500 million years the half of any mass of pure uranium would be converted into lead, the gas helium and other by-products.

Now when the earth began to cool off and the rocks began to crystalise, the helium and lead were imprisoned in the rocks. Before this crystallisation some of the helium was, of course, lost.

By careful and painstaking methods the lead and helium trapped in the rocks has been measured, and when compared with the proportion of unchanged uranium an ingenious index has been devised which gives the age of rocks from the time of solidification.

AGE OF ROCKS

This index shows that of the rocks of the earth the most ancient we can find are more than 1,800 million years old.

At first the earth was molten or plastic and moonless. Calculations have shown that it rotated once every four hours and that the sun alone exercised any influence and produced tides in the molten or plastic surface of the earth.

Now here the theory of resonance comes into the picture. Every substance has a natural period of resonance. You tap the skin of a drum. It gives out a note which is the natural period of vibration of the air inside the drum. It vibrates so many times a second. A wineglass has a natural period of vibration at so many times a second and gives out a note when you tap it. If a note of the same frequency is played on a violin it will set the winegless into vibration and in certain circumstances the glass may be set into such violent vibration that it will shatter.

Theoretically it is possible to demolish the Sydney Town Hall, or any other hall, for that matter, by first finding its natural period of vibration or resonance, then battering it with a ram at the same frequency. If this is carried out long enough the building will collapse.

As Sydney could do with a new Town Hall it is a pity we cannot carry out this procedure in practice!

Now it has been computed that the natural period of vibration of the earth in those far off years was not so many times a second but once every four hours.

Remember, then, that the earth was then revolving once every four hours. Therefore its plastic surface rose and fell by the attraction of the sun once every four hours which corresponded to the natural period of vibration of the earth.

As the wineglass shattered by the increased vibration at its natural frequency, so the plastic earth could not stand the constant strain, and it broke.

MOON'S ORBIT

A large piece separated and became the moon. Just as the now famous Sputnik was shot from the earth in a rocket to finally settle into an orbit, so the moon was shot from the earth in the same way and assumed an orbit also.

Calculations have shown that at the early period of its history the moon revolved around the earth once every four hours and that the earth revolved at the same period of four hours. Thus there were no tides of Lunar origin. The moon was only 8000 miles from the earth's centre.

A remarkable picture of Saturn and its ring system taken with the 10-inch Hooker telescope at Mt. Palomar. Distance—about 800-million miles.

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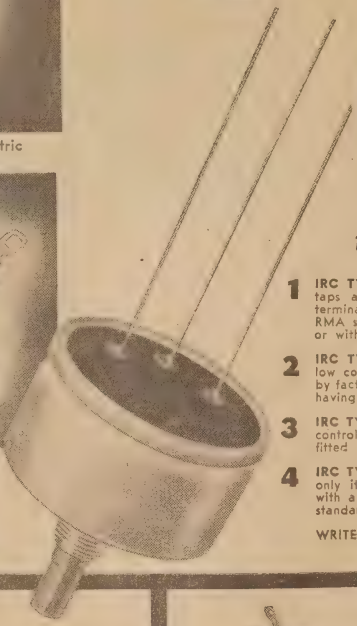

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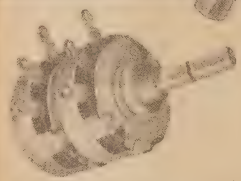

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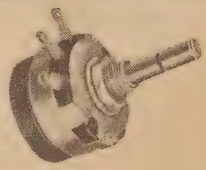
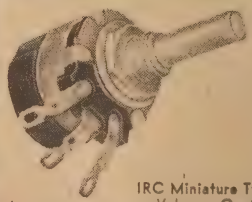


IRC Type CS Metallised Control



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There is a widespread belief that when the moon was torn from the earth there was merely a thin plastic crust covering the earth.

Thus when the moon went into space it left a mighty hole in the earth into which the plastic crust started to move to fill up. Before the process was complete, the crust solidified still further, and the hole was only partly filled in. What is left is the Pacific Ocean basin.

But as this crust started to flow into the hole on one side, it broke or split apart on the other, and formed the Atlantic Ocean.

By means of artificial explosions in the earth's surface and measurements of the speed of the resulting vibrations in the earth's surface, scientists can get an idea of the types of rocks at various depths below the earth's surface. Other instruments such as the pendulum which varies in its swing according to the weight of the underlying matter also enables the types of rocks to be determined.

GRANITE LAYER

Thus it has been found that the earth has an upper layer about 30 miles thick of solid granite, a lower layer of hot basalt 70 miles thick and a central molten core of pure iron and nickel.

Now theory has it that the thin layer of granite was there at the time of the moon's formation. If the moon was torn from the earth it should consist of granite and some basalt. Astronomical observations have shown that the moon actually consists of materials which have a density similar to that of granite and basalt, so the theory of the moons origin has some confirmation.

Now when the moon fled into space, it left that great hole in the earth as mentioned before. The moon tore out the granite crust and part of the molten or semi plastic layer of the underlying basalt. This latter would of course immediately begin to solidify, the upper crust cracked, and a peculiar thing began to happen.

Under the influence of the centrifugal force of the earth's rotation, the upper layers of granite, floating as they were on the semi-fluid basalt below, began to move towards the equator, and in the process were subject to great strains which caused the layer to crack.

THE CONTINENTS

These cracked-off pieces continued to move towards the equator until the basalt below completely solidified when the movement then ceased. Thus the continents were formed, and if you take the trouble you can cut out the continents from a globe and they will fit together like you fit a jigsaw puzzle which lends confirmation to the theory.

Further confirmation, comes from research into the ocean floor, which shows that the floor of the deepest part of the Pacific is basalt whilst the floor of the Atlantic has a thin layer of granite.

This seems to show that the Pacific is actually the hole left by the moon when it tore away the granite clean off the top of the basalt, whilst the partial filling in of the hole by the moving in of the upper granite layer caused the cracking which led to the formation of the Atlantic basin on the other side. The thin layer of granite on the floor of the Atlantic could have been left behind during the cracking process.

Relative position of fragments of the Earth's crust immediately after the separation of the Moon, according to one theory.

This is how the map of the world might look today if the separation of continents had not been stopped by the congealing of the basalt ocean.

It has been assumed that the solidification of the earth's surface was hastened by the fall of torrential rain which finally filled the holes in the earth's surface and thus the oceans and seas came into being.

Further indication that little change has occured in the position of the land surfaces or continents since the earth became solid is given by the fact that none of the continents contain rocks whose origin could have been the basins of the deep seas.

So the moon was torn from the earth's surface at least 1,800 million years ago. At that time, it was only 8000 miles from the centre of the earth.

What, then, caused it to move further away?

Science propounds an interesting theory.

EFFECT ON TIDES

The moon, in its orbit around the earth once in about 25 hours, and by means of its gravitational pull, not only tends to attract the water to itself, thus causing the ocean tides, but also tends to drag all this water along with it.

However, the moon does not find this an easy job owing to the friction which is exerted on the water whilst flowing or trying to flow through narrow straits, estuaries and so on, in its effort to follow the moon.

The result of this friction has been estimated to cause the revolution of the moon around the earth to slow down by one second in every 120 thousand years. It also slows down the earth's revolution, with the result that in a few billion years time the day on the earth will be one year long, so that one-half of the earth will be permanently dark.

In addition, according to Henry Chapin and F. G. Walton Smith, this tidal brake will result in increasing the distance of the moon from the earth by five feet every hundred years.

NIGHT AND DAY

All this won't affect us very much unless someone discovers a method of everlasting life. But who wants everlasting life if one-half the earth is always daytime and one-half dark? One would lie awake in bed for one year on one side of the earth and sleep for a year on the other side.

What a life!

But it does explain why the moon was only 8,000 miles away at its formation and why it is 250,000 or so miles away now.

At least my information says that the scientists have worked backwards in time on the above basis and found all this out. I intend to take their word for it. I haven't worked it out to check their figures. If any readers do and find them wrong, then let me know the answer and I will take it up with the proper authorities.

(Continued on Page 123)

TEST GEAR COSTS YOU LESS!

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VACUUM TUBE VOLTMETER Model EVK

Model EVK incorporates the W4 all polystyrene meter and overall size is only 8in x 6in x less than 4in. Designed to operate from 240 A.C. mains, it comes complete with every component. All resistors, shunts, multiplier, meter, etc., are carefully pre-calibrated at the factory.

The easy to follow instruction booklet supplied with every Model EVK is filled with diagrams and stage by stage assembling and wiring steps.

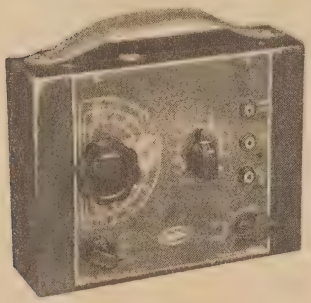
The ranges of Model EVK are:

D.C. Volts: 0-5-10-25-50-100-200-500-1,000.

A.C. Volts: 0-10-40-50-200-250-1,000.

Ohms : 0-1,000-100, 000-10 Meg.—1,000 Meg.

A polarity reversing switch is fitted for D.C. voltage range.

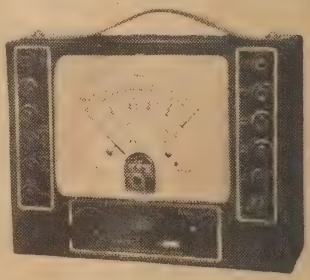


OSCILLATOR KIT Model OK1

Available as complete kit or assembled. Covers all fundamental frequencies in the average receiver. Standard batteries are used and each OK1 is supplied complete with instruction book.

MULTIMETER KIT Model MK1

Has a wide range of A.C. and D.C. voltages up to 1,000 volts and measures current in the range of 1, 10, 50, and 250 milliamperes, and resistance readings up to 100,000 ohms. Has U4 square meter with clear multi-scale. Supplied either as a kit or assembled. Full details for assembly are given—photos and diagrams make job easy.



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Technical Review

NEW AMPLIFIER INCLUDES NOVEL PHASE SPLITTER

An elaborate stereo amplifier is described in the November 1957 issue of "Audio". Perhaps the most interesting thing about this amplifier from our point of view is the method of providing out of phase drive for the output valves.

A SIMPLIFIED circuit of the phase splitter is given separately. A cathode follower provides simultaneous audio signal voltage to the cathode of one driver and the grid of the opposing driver

A plate voltage dropping resistor — well bypassed — is used in the cathode follower plate circuit. This is important to establish operation of the follower on the same part of the dynamic characteristic as the phase opposed drivers. Also observe that the energised grid and cathode circuit capacitances of the drivers (including strays) are effectively in parallel across the low source impedance of the cathode follower.

BALANCED "C"

This means that the shunt RC product is held to a small value and is virtually identical for the two drivers—a condition which makes it possible to obtain perfectly balanced driving voltages across more than the complete audio spectrum.

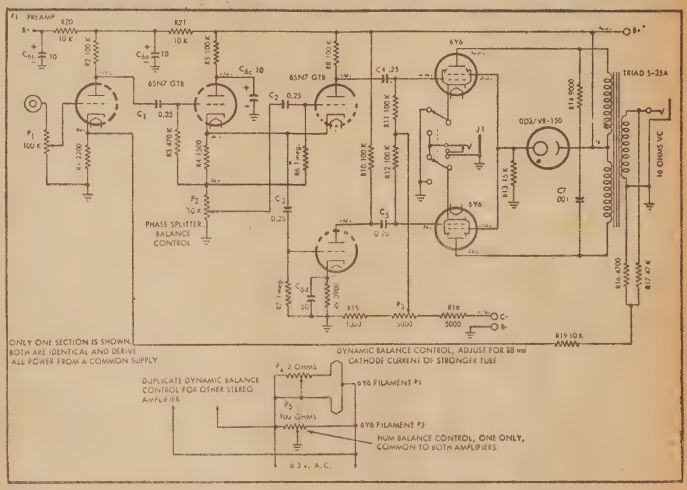
The phase-splitter balance control is a 10,000 ohm wire wound potentiometer in the cathode-to-ground circuit of the follower. Balance will be obtained with the arm set about 1,000 ohms up from the ground.

If you have no test equipment available, the phase splitter may be balanced as follows: Connect a temporary short lead from grid to grid of the 6Y6 final—pull out one of the 6Y6 valves and balance for null or low music level. Remove the short and plug the 6Y6 back in its socket.

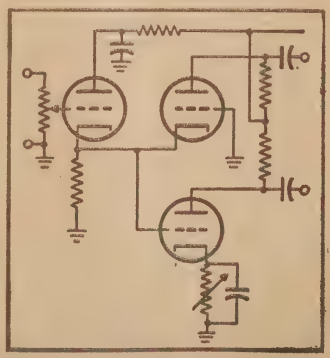
While much has been written about the two valve "self-balancing" phase splitters, some rather important defects are generally ignored or glossed over. The phase inverted side causes the signal to go through one more valve than the "direct side." This usually leads to higher distortion and unequal phase rotation with attendant balance difficulties at frequency extremes.

No one would be so optimistic as to expect high quality performance from a final stage with one flat valve. Obviously, the same thing applies to the drivers. When one valve is badly off in a pair of phase opposed drivers, a self-balancing circuit only insures that the flat valve will be driven harder, with inevitable increase of distortion.

Valves in high class equipment should be tested periodically and replaced when necessary. In this amplifier the use of the improved 6SN7GTB at plate currents of only 1.3 mA in each triode section serves to insure long trouble free performance from a circuit which may be set precisely for balanced operation.


PREAMP
6SN7 GTB
6Y6
TRIAD S-35A
OD3/VR-150
PHASE SPLITTER BALANCE CONTROL
ONLY ONE SECTION IS SHOWN. BOTH ARE IDENTICAL AND DERIVE ALL POWER FROM A COMMON SUPPLY
DYNAMIC BALANCE CONTROL, ADJUST FOR 28 ma CATHODE CURRENT OF STRONGER TUBE
DUPLICATE DYNAMIC BALANCE CONTROL FOR OTHER STEREO AMPLIFIER
6Y6 FILAMENT #1
6Y6 FILAMENT #2
HUM BALANCE CONTROL, ONE ONLY, COMMON TO BOTH AMPLIFIERS.
6.3 v. A.C.

Overall circuit of one of the amplifiers in the dual channel equipment. Both amplifiers are identical and are built on a single chassis. The main interest centres around the phase splitter and method of balancing the output valves.



A simplified circuit of the phase splitter circuit which is capable of excellent balance throughout the audio range

The choice of 6Y6 output valves was made after testing many different beam valves in both triode and pentode connection. These valves have the advantage of high power output at moderate plate supply voltages. In addition, the optimum plate to plate load impedance is lower than for most beam types and permits better low-frequency performance from a given amount of iron and copper in the output transformer.

The 6Y6 output valves are operated at 300 to 325 plate volts and an OD3/VR150 gas tube is used as a series dropping device to maintain the screen voltages precisely 150 volts lower than the plate supply. The 15,000-ohm resistor from screen circuits to ground keeps about 12 mA of gas-tube current flowing and stabilises operation.

Improved low-frequency performance is assured by both dynamic and static balancing of the output stage. Most amplifiers—where balance adjustments are provided at all—permit balancing of only static cathode current values. This is usually arranged as either a variable cathode bias or grid bias circuit which permits reducing the plate current of the "high" valve to match the lower valve. Unfortunately this type of balancing generally leads to even poorer

(Continued on page 23)

The WARBURTON FRANKI Page

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Power Transformers 40mA 225V a side. 35/- ea.
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Size: 4¾in x 3½in x 1¼in.
Model TK-50 is a pocket size individual jack type circuit tester with an insulated panel and steel cabinet.
D.C. Volts: 10/25/500/1000V (1000 ohm/V)
A.C. Volts: 10/250/500/1000V (1000 ohm/V)
D.C. Current: 1·250mA.
Resistance: 10/100 K ohm (By 1.5V internal battery).

Price: £8/19/6
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MODEL TK-70

Size: 5in x 3½in x 1¼in.
Model TK-70 is a pocket size rotary switch type circuit tester with an insulated panel and steel cabinet.
D.C. Volts: 10/50/250/500/1000V (2000 ohm/V)
A.C. Volts: 10/50/250/500/1000V (2000 ohm/V)
D.C. Current: 500 uA/25/500mA.
Resistance: 10K ohm/1 Meg. ohm (By 3V internal battery).
Decibels: Minus 20 to plus 22db.
Plus 20 to plus 36 db.

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MODEL TK-90

Size: 6in x 4in x 2¾in
Model TK-90 is a handy size rotary switch type circuit tester with a black bakelite panel and cabinet, having a high sensitivity.
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A.C. Volts: 10/50/250/500/1000V (8,000 ohms/V)
D.C. Current: 50 uA/2.5/25/250mA.
Resistance: 5/50/500 K. ohm/5Meg. ohm (By 3V internal battery).
Decibels: Minus 20 to plus 5 db.
(0db minus .0775V minus 600 ohm).
Plus 5 to plus 22 db.

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NEW MECHANISM IN TELERECORDING EQUIPMENT

Telerecording forms an important part of modern television programme techniques, for by this means, a programme can be transferred to film for use on subsequent occasions.

BASICALLY, this is achieved by feeding the video signals and synchronising pulses to a cathode ray tube capable of producing an intensely bright, short persistance picture. This picture is optically focused on to a "frame" of negative film stock and thereby photographed, the film then being moved on one "frame" for the taking of the next picture, and so on. The reel of the film is then developed and processed in the normal way for future use.

Although theoretically straightforward, the practical realisation of such an equipment poses many problems. For instance, in order to record full picture information, the film must be stationary in the gate for the period of the two scanning fields which make up one complete television frame of picture; this means that the only time left in which it can be moved on for the next exposure is in the brief blanking period between television frames.

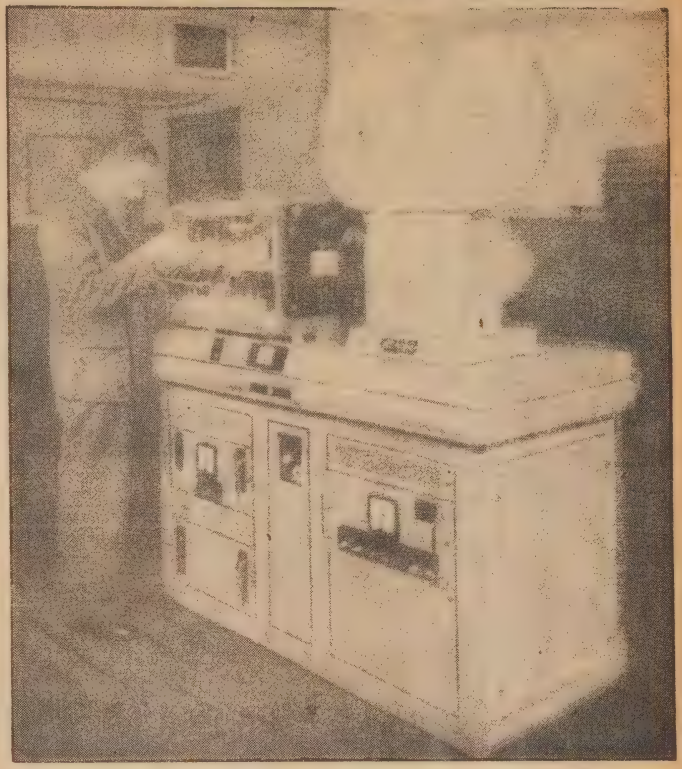
TWO REQUIREMENTS

As this blanking period varies between 1.4 and 1.8 milliseconds, two opposing requirements have somehow to be reconciled. Firstly, the film must (ideally) be pulled down into position in this exceedingly fast time, as any overlap into the period when the television picture is being built up by the normal scanning process will mean that some of the scanning lines (and therefore picture-content) are not registered on the film.

In practice, the loss of a few lines is not of great importance; nevertheless, the nearer the pull-down time approaches these limits the better will be the quality of the filmed picture.

Secondly, it is naturally of prime importance that the film itself must not suffer physical injury in the process of being pulled down.

Pull-down times in use on conventional interrupted cameras have been so long as to make the arrangement quite unworkable, and hitherto the practice has been to record only alternate television frames, the others being blanked out and the intervals used as "breathing spaces" in which the film is pulled down.



A view of the Marconi Type BD679 Telerecording equipment with the underside of the sub chassis exposed. Units are hinged for servicing.

The Marconi Telerecording Equipment Type BD.679 incorporates an entirely new and exclusive fast pull-down mechanism which operates in the normal time of 2 milliseconds, but which can be adjusted to give a pull-down actually within the blanking period. A very light gate-pressure is employed, while positive registration of the film is achieved against a sapphire-tipped claw. The fast pull-down mechanism itself is totally enclosed in an oil-bath and can be quickly removed as a subunit. A very simple optical system is incorporated which ensures that there is negligible loss of contrast in the recording due to scatter.

RECORDING MONITOR

The recording monitor, the function of which is to generate (from the externally supplied video signals) an intense high-quality picture for focusing on to the film, is mounted on a swivel head, and may be swung through 90 degrees to facilitate removal of the recorder cathode-ray tube. Due to the flexible design of this unit, any magnetically-focused tube of a diameter between 5in and 10in can be used.

A Flywheel Sync. Panel can be supplied as an optical extra for the regeneration of line and field pulses when the recording is made from a remote location.

NOVEL PHASE SPLITTER

(Continued from Page 21)

conditions of dynamic balance at medium and high level plate current excursions.

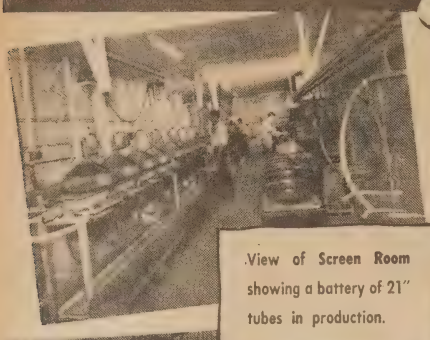
In the stereo/monaural amplifier, both output valves in either push-pull pair have identical, fixed bias grid voltages. A cathode current jack and switch permits comparing the cathode currents. The common bias control is adjusted to produce 38 mA of cathode current for the lowest valve's plate current with the filament control p4 set for zero resistance.

If the "high" valve is in the socket which has the filament control, it is only necessary to reduce the filament voltage slowly until 38 mA plate current is obtained. If the high valve is in the wrong socket, merely interchange the output valves and proceed as described. Obviously we are balancing by means of reducing the emission of the "hotter" valve. Extensive testing has verified that this method results in improved dynamic balance and sustains the delivery of full power at low frequencies.

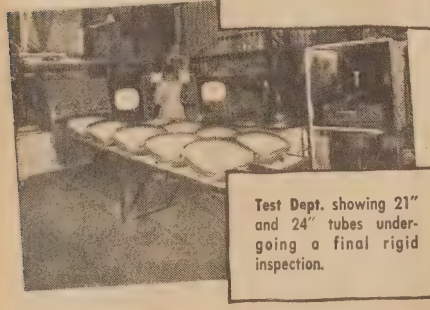
The 9,000-ohm wire wound resistor and .001-UF capacitor from plate to plate of each output stage, serves to neutralise any ringing tendency with the value of negative feedback employed. Feedback is taken from a voltage divider across the voice-coil winding of the output transformer and is otherwise conventional.

The amount of inverse feedback used is deliberately held to about 10 db. The amplifier is easily driven to full output from less than one volt of input signal.

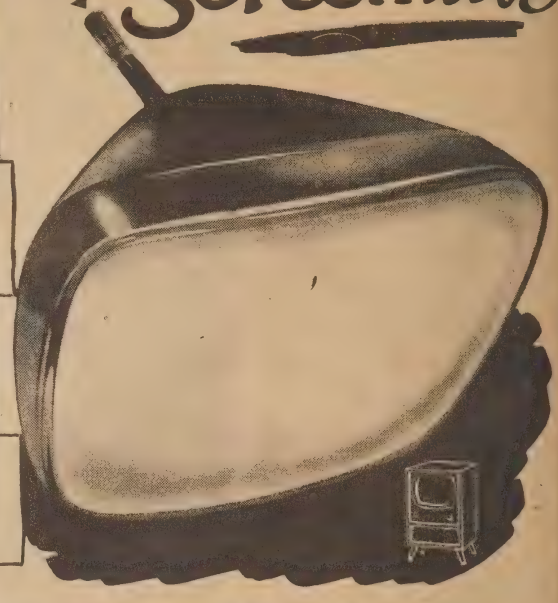
Your Eyes — will make you Screenwise



View of Screen Room showing a battery of 21" tubes in production.



Test Dept. showing 21" and 24" tubes undergoing a final rigid inspection.



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SINGLE SIDEBAND LINKS CANADIAN TRAPPERS

A low power SSB radiotelephone network connects isolated fur trading posts throughout northern Canada. The system has provided ideal communication between stations within a 200 to 500 mile range and it has been demonstrated that 30 to 50 watt SSB peak envelope power transmitters are able to pass traffic when 150 to 350 watt AM systems cannot.

Between 1948 and 1953 the Canadian north opened up at a tremendous pace due to modern air transportation. Coincident with mining developments, projected airline routes and radar lines, the demand for the use of radio frequencies in the HF spectrum increased one hundred fold.

The Hudson's Bay Company's 180 fur trading posts, located between lat. 50 deg. north to 500 miles north of the Arctic Circle and from British Columbia in the west to the Labrador coast in the east, found it increasingly difficult to get a northern staff trained as CW operators in addition to their regular merchandising duties.

GREATER TRAFFIC

At the same time, the amount of radio traffic handled over the company's system increased greatly due to traffic from government departments concerning the health and welfare of the Indians and Eskimos in the north.

It was obvious that an AM emission would only increase congestion in the HF band. Reliability of communication would not improve and privacy of radio traffic would be non-existant.

In 1953, eight experimental SSB low power radio stations were set up around James Bay, at the southern end of Hudson Bay. The transmitters were of amateur design, modified for a commercial frequency. Crystal lattice network filters were used to generate the lower sideband signal. The peak envelope power of these units was 10 watts. The receivers were the fixed frequency AM type, diode detection and SSB signals were received by injecting some of the transmitter signal at the aerial terminals of the receiver.

SSB PROVED BETTER

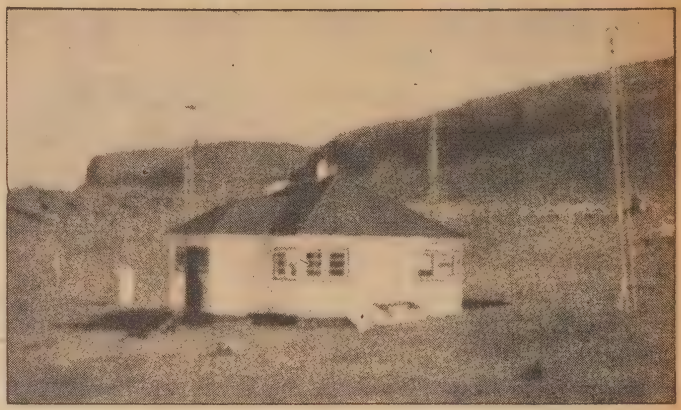
Data compiled from this 8 station network definitely that for network operation, at least, where low power was involved, SSB operation was vastly superior to AM, especially in primary power requirements, reliability of signal under adverse radio conditions and speech privacy.

The transmitter used in the SSB system eventually was designed to give the maximum power output for a given line voltage drain. The power source is 32 volts from batteries, max. current drain is 10 amps.

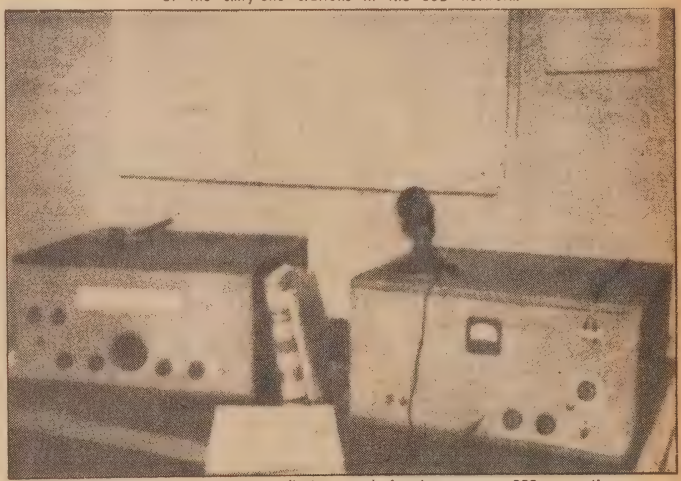
Inverters change the 32V DC to 115V AC and place a total limit of approximately 200 watts for both transmitter and receiver. Separate inverters for both transmitter and receiver improve the voltage regulation.

The transmitter requires 150 watts and the receiver requires 100 watts, or a total of 250 watts. A push-to-talk system disables part of the transmitter during reception and part of the receiver during transmission to fit the 200 watt limit.

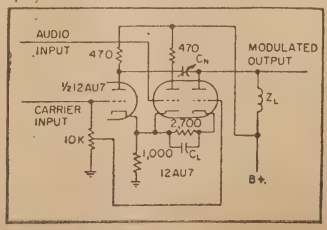
In the transmitter, supply voltage for the final amplifier valves is limited to hold the power drain within 150 watts. This results in a peak envelope power output of 30 watts. If power drain is not critical, the final amplifier output can be boosted to approx. 60 watts peak envelope power by raising the supply voltage to the final valves.



Typical radio station at Holman Island, 400 miles north of the Arctic Circle, is one of the sixty-one stations in the SSB network.



Receiver and transmitter installation used for low power SSB operation.



Triple-triode balanced modulator used in the transmitter.

Beam power amplifiers, type 6146 in push pull, were chosen as the final amplifiers. They operate close to their class C efficiency yet still in their linear condition. Overall efficiency with respect to power drain is therefore relatively high.

The transmitter uses filter type sideband separation with mechanical filters. The triple-triode balanced modulator, shown in the diagram, is used because of its simplicity. Output of the balanced modulator is fed to the sideband filter for single-sideband operation, or combined with the carrier to give AM output. For CW operation, the unmodulated carrier is switched to the amplifier stages.

After proper amplification, the 455 Kc sideband output is fed to a balanced converter to produce the operating frequency. This converter feeds the final driver amplifier and the final linear stage Antenna is matched by tapping on a link-coupled tuned circuit.

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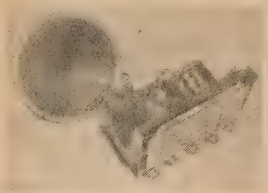

RADIOGRAM CHASSIS

These radiogram chassis were specifically designed for good quality reproduction of both records and radio programs. A special inverse feed-back circuit is employed and well-known American type valves are used, tone and automatic volume controls are incorporated.

The dial is made of perspex and all local stations for each capital city are in large letters and country stations in small. Dial colours are Gold, Maroon, Black and Yellow.

5 Valve Broadcast with 7 inch Speaker £13/19/6

5 Valve Broadcast with 12 inch Speaker £15/19/6

CHIEFTAIN MULTIMETER

An ideal pocket-sized meter in a plastic case overall sizes 5½ x 3¾ x 2 3/8 inches. The meter has 100 ohms per volt sensitivity. Voltage readings are 0-15, 0-150, 0-300, 0-600 and ohms scale reads 01-100,000 ohms. This multimeter is ideal for the hobbyist motor mechanic, radio serviceman and electrician.

Price only £4/12/6.

ALUMINIUM CHASSIS

Stocks of the following blank aluminium chassis available for immediate delivery.

5	x	3	x 2	6/9
6	x	4	x 2	7/6
8	x	5	x 2½	10/-
10	x	6	x 2½	12/-
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13	x	7	x 2½	14/-
13	x	10	x 2½	17/6
17	x	8	x 3	22/6
17	x	10	x 3	25/6
17	x	12	x 3	26/-

COLLARO TRANSCRIPTION DISCS

These are especially designed for Hi-Fi and use heavy turntable and precision pick-up arm with efficient counterbalance.

Price with Pick-Up £31/2/6
Price less Pick-Up £26/7/6

COLLARO TAPE DECKS

Ideal for the home builder to make up into an efficient tape recorder.

Price with heads .. .. .. £ 52/19/6

PHILIPS TAPE RECORDERS

Model EL 3517 fully imported recorders use 5in reels tape play for 1 hour on standard tape, 1½ hours on L.P. tape, speed of tape 3¾ inches per second, frequency range 60-8KC.

Built-in 6 x 4 oval speaker.
Output 2.5 Watts.
Dimensions 14 x 13 x 7½ inches.
Weight 23lb.
This is an excellent recorder for office or home use is every compact and a good buy at

£110/5/0.

RECORDING TAPE

Scotch Boy, 1200ft £3/10/0
Agfa, 600ft £1/10/0
Magnetophon standard
1200ft £3/5/0
LP. 1700ft £4/15/6
Aurovox, 1200ft £2/14/4

★ SPECIALS ★

1. **1 amp Selenium rectifiers** for 6 and 12 volt battery chargers Brand new English make. **22/6 each**
2. .25 mfd., 3,000 volt Wkg. Block Condensers brand new and perfect. **3/9 each.**
3. .001 — 5,000 Volt Mica Condensers **2/6 ea.**
4. **Transmitting Crystals.** We have a large assortment ranging from 2120 KC to 4665 KC with 7 pin base. Please let us know your requirements and we will reply by return and notify you if the frequency is available and if not the nearest lower frequency. **Price only 17/6.**
5. **Coil Winding Wires.** Wind your own coils for crystal, valve sets etc. Below are listed popular wires and prices per yard and per ¼lb reel.

B and S.	SWG	Enamelled per yd.	Enamelled per ¼lb reel
15	17	5d.	
16	18	4d.	
18	19	4d.	7/6
20	21	4d.	8/-
22	23	3d.	8/3
24	25	2d.	8/9
26	27	2d.	9/4
27	29	2d.	
28	30	1d.	10/9
29	31	1d.	
30	33	1d.	11/3
33	37	1d.	14/6

6. **Bakelite Formers** can be supplied cut to the length you require.

Diameter	Price per inch
¾ inch	5d.
1 inch	5d.
1¼ inch	6d.
1½ inch	6d.
2 inch	8d.
2½ inch	9d.
3 inch	10d

7. **Single Gang Condenser.** Ideal for crystal, valve sets etc. 0004 capacity Brand new **12/6 each**
8. **Germanium Diodes.** English make, brand new and perfect, ideal for use as crystal detectors, rectifiers, etc. **4/11 each**
9. 50,000 ohm. W.W. resistors on ceramic formers 5 per cent. accuracy, 5watts. **2/- ea**
10. **3 inch Extension Speakers,** in bakelite case assorted colours. **Price 22/6 each.**
11. **Ferrexcube Rod Aerials** with coil ideal for portables and valve sets. Equal to 60ft outdoor aerial **Price 16/6 each**
12. **High Tension Power Supply Transformers.** These give 2000 Volts DC to work VCR9 or 5BP1 tubes for oscilloscopes or T.V. sets Circuit for high frequency power supply with each transformer. **Price 18/6 each**
13. 4 mfd. 500 Volt Wkg. Block Condensers small size, approx 2 inches square Brand new and perfect. **5/9 each**
14. 10 mfd. 40 P.V. Electrolytic Condensers. Brand new, well-known make **Only 6d. ea.**
15. 25 mfd. 40 P.V. Electrolytic Condensers. Brand new, well-known make. **2/1 each.**
16. 50PF 2.5KV. Mica Condensers. **1/- each.**
17. T.V. I.F. strip kits Video. Consists of chassis with 5 IF transformers and traps.
Circuit provided with each kit. **£3/15/-**
18. T.V. I.F. strip Kits. Sound consists of chassis with 2-5.5 MC/s transformers and 1 ratio detector. Circuit provided with each kit. **Price £3/-/-**
19. Combined Video and Sound I.F. strip kit, consisting of chassis and I.F. Circuit supplied with each. **Price £6/15/-**
20. 3 Channel Incremental tuner kit, chassis switch fine tuning condenser coils and coupling transformer. **Price only 75/-** Circuit supplied with each.

SPECIAL NOTICE

All parcels sent Registered Post unless otherwise stated. Postage or Freight must be included with order

547 ELIZABETH STREET, MELBOURNE — Phone FY0271

Branches throughout Victoria and Riverina

Although requirements called for a single fixed transmitter frequency, by changing the coils the transmitter is adapted to three different frequency ranges, 1.5 to 2.6, 2.5 to 4.4 and 4.3 to 7.6 Mc. Since the operational frequency does not go higher than 7.6 Mc, only a single conversion is required from 455 Kc to the operating frequency.

The transmitter produces 30 watts peak envelope power in single-sideband operation, 15 watts rms CW and 6 watts rms AM carrier. Single sideband rejection is better than 35 db and cross modulation is better than 40 db. Harmonic distortion is less than 2 pc with audio response from 300 to 3,200 cycles plus or minus 3 db. The aerial output is arranged for a balanced 75 ohm line feeding a doublet cut to the operational frequency.

MECHANICAL FILTER

The receiver uses the same 455 Kc mechanical filter for sideband separation. Crystal carrier oscillators are located on the skirts of the mechanical filters. This arrangement calls for retuning the receiver when reception is changed from one sideband to the other. However, a quick switch from one sideband to the other is not usually required.

The tuning range, 1.5 to 7.5 Mc is covered in three bands. A switch selects the upper sideband, the lower sideband, or AM with diode detection. Continuous wave is received on either the upper or lower sideband position.

The receiver input is balanced at 75 ohms for connection to the transmitter antenna.

One stage of frequency conversion converts the operational frequency to the 455 Kc IF system. The mechanical filter provides all of the IF selectivity with the exception of one transformer. The local oscillator can be either variable or fixed tuned by any of three crystals.

The crystal carrier oscillators feed a triple triode product detector (see diagram) for SSB or CW reception. For AVC and AM diode reception the mechanical filter feeds a diode detecting system. The audio system provides two watts output to a built-in loudspeaker.

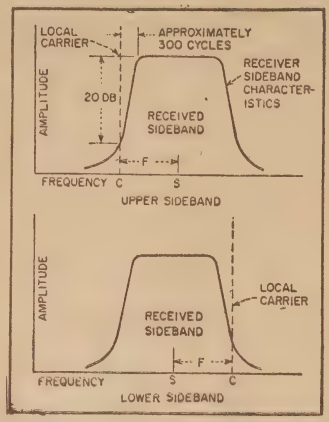
Audio response of the receiver is 300 to 3,200 cps. Sideband rejection of approximately 30 db is obtained with distortion of less than 3 pc. Cross modulation is better than 40 db.

RELIABILITY GOOD

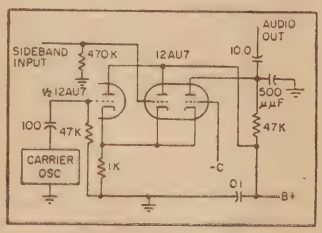
This SSB northern radio network has been in operation 18 months at the time of writing. Reliability of communication in the HF band between stations using low power at ranges of 200 to 500 miles has increased remarkably through SSB. This installation shows that 30 to 50 watt peak-envelope-power SSB stations out-perform 150 to 350 watt AM stations especially when radio conditions are poor and QRM is at its worst. During the early hours of darkness when tropical broadcasting and radioteletype make traffic handling practically impossible from 150 to 350 watt AM stations, these 50 watt SSB stations continue to pass traffic.

With sideband suppression of 40 to 50 db, it is practical to operate one section of the radio network on the upper sideband and another section on the lower with no appreciable interference between the two sections, even though many of the stations on the opposite sidebands are separated by distances ranging from 200 to 250 miles. This indicates the practical appeal of SSB transmission for government agencies and private firms as it gives two frequencies for any one frequency assigned in the very conjected HF spectrum.

Reliability is increased due to the complete use of receiver-type valves



Sideband filter and local carrier placement.



Triple-triode product detector in receiver is used for SSB and CW detection.

other than the AB2 linear amplifier, both in the transmitter and receiver and the absence of high wattage primary power and the use of mechanical filters in the generation of the sideband. Good reliability is of great importance to any communication system operated in extremely isolated areas by non-technical personnel. (Electronics.)

AUSTRALIA should have a giant radio telescope for radio astronomy in five years' time according to Dr Wild, a member of the C.S.I.R.O. Division of Radio physics.

He described the telescope in a lecture to science teachers attending the Nuclear Research Foundation Summer School at Sydney University.

Dr Wild said the telescope would be 225 feet in diameter and 200 feet high.

The telescope would be only 25 feet smaller than the world's biggest at Jodrell Bank, near Manchester.

This telescope had cost £1,000,000.

Dr Wild said the Australian telescope would cost £500,000.

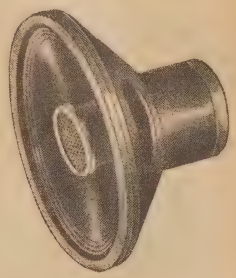
The Carnegie Foundation would provide £89,200 and the Rockefeller Foundation £115,000 toward the cost of the telescope.

The Commonwealth Government would pay the rest.

"Been to an ORCHESTRAL CONCERT lately?"

PARDON OUR ASKING, but the quality of sound which quite a lot of people appear to find satisfactory makes us wonder if they have ever heard an orchestra 'in the flesh'. If you are thinking of buying a new loudspeaker, or even if you're not for that matter, why not spend just a few shillings on refreshing your memory as to what an orchestra really sounds like? If you find it free of the booming bass and tizzing treble which has probably become associated in your mind with much audio equipment you will be in the right frame of mind to appreciate the Vitavox DU120 Duplex Coaxial Loudspeaker—the loudspeaker which adds so little to the original sound.

VITAVOX



DU 120 DUPLEX COAXIAL FULL RANGE LOUDSPEAKER

Available from all Wholesale Houses

Retail Price: £49/6/3

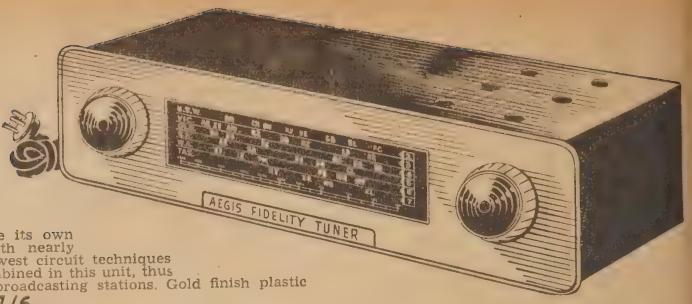
Australian Factory Representatives

R. H. CUNNINGHAM PTY. LTD.

8 Bromham Place, Richmond Victoria. JB1614

16 Angas St., Meadowbank N.S.W. WY0316

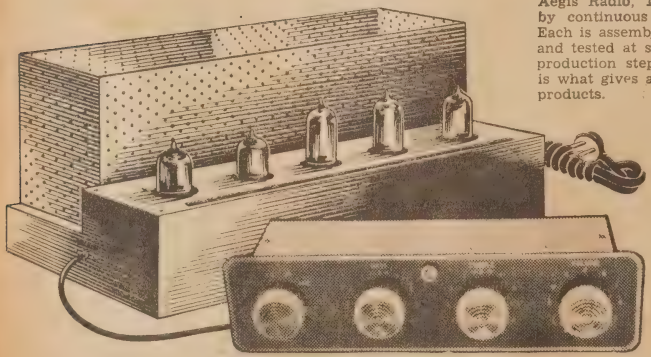
AEGIS FIDELITY TUNER (Mark 2)



Aegis Fidelity Tuner Mark 2 (at top of page) has been designed for building-in purposes and does not incorporate its own power supply. I.F. stage has band width nearly double that of ordinary receivers. The newest circuit techniques and miniaturisation of components are combined in this unit, thus assuring you the desired response from broadcasting stations. Gold finish plastic front panel. Retail price **£32/17/6**

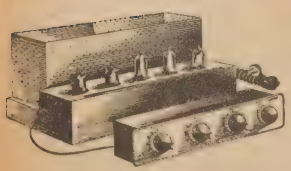
• At right, we have illustrated the **Aegis Mark I Tuner.** It features newest circuit techniques and miniaturisation of components. I.F. Stage has band width nearly double that of ordinary receivers. Combined with any good treble boost of an amplifier (preferably the AEGIS Mullard 5-10) will give the desired response from broadcasting stations. Incorporates its own power supply. It retails at **£35**

AEGIS AUSTRALIA'S OWN BRAND OF HIGH FIDELITY EQUIPMENT!



Aegis Radio, TV and High Fidelity components are backed by continuous research for greater reliability and service. Each is assembled under the supervision of a skilled operator and tested at several points along the production line. Every production step is rigidly controlled! This painstaking care is what gives a high "IQ" — INBUILT QUALITY — to Aegis products.

AEGIS FIVE-TEN "PLUS" HIGH-FIDELITY AMPLIFIER



Aegis Five Ten "Plus" (above) follows the same valve line-up as the Aegis-Mullard 5/10 amplifier (illus. below) but incorporates a valve pre-amp, which allows the use of lower gain pick-ups and improved bass and treble compensation. Control panel 12in x 3in x 1¾in. Retail price **£74/5/-**

• Illus. at left is the **AEGIS Mullard 5-10 Hi-Fidelity Amplifier.** Rated power output 10W. Max. 12-13W. Frequency response plus or minus 0.5 db, 10 c/s to 20,000 c/s. Alternative impedances available. Amp.: 11¾in x 6¾in. Control panel: 12in x 3in x 1¾in. It retails at **£59** Write for leaflets of each.

Manufactured in Australia by

AGENTS IN ALL AUST. STATES

AEGIS MANUFACTURING CO. PTY. LTD.
206 LITTLE LONSDALE ST. MELB. VIC. FB 3731

NEWS AND VIEWS OF THE MONTH

Hope for Limbless

BRITISH scientists have found a means of linking the human brain to an artificial limb.

The invention — called an "electric muscle" enables cripples to move artificial hands and fingers at will.

Mr Norman Walker, who helped perfect the invention, has resigned his Government research job and opened a factory in the United States with Government contracts.

Mr Walker a guided weapons expert, carried on from the experiments of London specialist, Dr Alfred Nightingale.

Dr Nightingale found that minute electric currents generated in muscles in the remaining part of a limb could be detected and put to work.

Dr Nightingale said, "I believed that if a limbless man willed his phantom hand to clench, I could amplify electrical forces in muscles to clench a mechanical hand."

Dr Nightingale did this — but it took a table-load of electronic equipment to move the mechanical hand.

Mr Walker and other missile scientists, working in their spare time, produced an amplifier and relay equipment set similar to Dr Nightingale's — but in a 4in square box.

★ ★ ★

Russian Sleepmaker

AUSTRALIAN scientists have been impressed by an electric "sleep-inducer" which is part of the hospital equipment at Russia's main Antarctic base at Mirny.

It is apparently used in the treatment of cases of extreme exhaustion or neurosis caused by the monotonous regime of life during the Polar night or by the feeling of isolation.

Insomnia and anxiety symptoms are often troublesome in any winter party.

The patient is placed on a table and electrodes are affixed over each eye and to the back of the neck by rubber bands.

A rhythmical current is then passed through the head and the patient almost immediately falls into a deep sleep.

The apparatus is removed after one hour, but the Russians claim deep and relaxing sleep thereafter continues for some hours.

★ ★ ★

A touch of humour

IN Minneapolis, firemen really throw themselves into their work. They have been answering calls with such vigour that in the past four years 14 of them have been injured by crashing into the hard floor as, with sleep barely from their eyes, they slid down the greasy pole.

But the Fire Chief had the answer. At the bottom of each pole he installed a soft pad.

The problem now is to wake up the really tired man who imagines he has climbed back into bed.

★ ★ ★

Danzig has a "sobering station" in which citizens overcome with the joy of living can recover in peace and safety. A news item from Warsaw Radio recently announced that the station had admitted its 1,000 drunk. To mark the occasion, arrangements were made to present him with a suitable souvenir on behalf of the management.

But the presentation was not made. The ungrateful patron disqualified himself by breaking up the furniture, in a last exuberant fling.

B.B.C. Tries Stereo

THE B.B.C. recently carried out some interesting experiments with stereo transmission by broadcasting simultaneously the two channels from different stations.

The left hand speaker channel came from the TV transmitter at Crystal Palace, and the FM station on 91.3 Mc at Wrotham.

The right hand speaker channel was put over the Home Service from Brookman's Park on 330 metres and the FM Home Service from Wrotham on 93.5 Mc.

Reports received next day (Jan. 14), indicated great public interest and a successful experiment.

B.B.C. comment was as follows:—

The experiments were successful in showing that a stereophonic effect could be achieved by using a stereophonic tape recording in conjunction with dual transmitters and dual receivers.

1. It was not expected that perfect stereophony would be achieved within the limits of the experiment because it was not possible to ensure that the two transmission channels were identical in each case. Moreover, few listeners have

POPULAR SCIENCE QUIZ

Q. Why don't engineers dig a tunnel between England and the Continent? Surely this would have great economic advantages?

A. This is a very old proposal, dating back hundreds of years. So far a big factor against has been the value of the English Channel as a barrier to a possible invading force, and even as late as the last war a tunnel would have been of the greatest value to whoever controlled its entrance and exit.

Today the Channel hasn't so great a defence value, and the construction of a tunnel might yet eventuate. As a matter of fact, a start was made on a tunnel in the last half of the last century, and a seven foot diameter heading exists at both English and French ends. The hard, durable chalk, so characteristic of Dover is particularly suitable for tunnelling, and names and dates originally carved in the portions of the existing tunnel are still sharp and clean. The chalk layers are believed to be continuous across the Channel and the tunnel, if built, need descend probably no more than about 300ft.

Q. Is it possible to decontaminate water which has been exposed to radio-active pollution?

A. It is apparently much easier to decontaminate water than solids. Water which filters through ordinary clay will leave most of its unwanted activity behind it. According to tests made by the U.S. Army, less than an ounce of powdered shale stirred into a pint of water and allowed to settle for half-an-hour will remove from 65 to 100 per cent of contamination. Even rivers after the water has flowed for some distance appreciably reduce the amount of radio-activity originally detected at a given point.

Q. Could we drink heavy water.

A. The only obvious difference between heavy water and ordinary water is that the former is twice as heavy. It is not likely that anyone would want to drink something as scarce and costly, but it is more than twenty years since initial experiments were made by feeding it to mice in a laboratory. In every case the mice died. Apparently deuterium, the heavy isotope of hydrogen, is sufficiently different physically to upset the normal processes of metabolism. First symptoms of illness appeared when one in five of the hydrogen atoms in mice's bodies were replaced by deuterium atoms. Death occured when the ratio equalled one in three. The leukaemic cells were apparently more sensitive than others. So it seems that drinking heavy water is likely to be as dangerous as it is expensive.

ELECTRONIC

A&R

EQUIPMENT

Transformers

FOR THE ULTIMATE IN ...

...performance...reliability...appearance!

POWER TRANSFORMERS

Type	D.C. mA	Prim. Volts.	Sec. Volts.	Filaments
1763	100	200 — 230 — 240	300-CT-300	5V-2A; 2 x 6.3V — 2A
1764	"	" " "	325-CT-325	" " "
1765	"	" " "	385-CT-385	" "
1766	125	" " "	285-CT-285	" "
1767	"	" " "	300-CT-300	" "
1768	"	" " "	325-CT-325	" "
1769	"	" " "	350-CT-350	" "
1770	"	" " "	385-CT-385	" "
1771	150	" " "	285-CT-285	5V-3A; 6.3-2A; 6.3-CT-2A
1772	"	" " "	325-CT-325	" " "
1773	"	" " "	350-CT-350	5V-3A; 6.3-3A; 6.3-CT-3A
1774	"	" " "	385-CT-385	5V-3A; 6.3-CT-3A; 2.5-5A

Type	D.C. mA	Prim. Volts.	Sec. Volts	Filaments
1775	150	200 — 230 — 240	385-CT-385	5V-3A; 6.3-3A; 6.3-CT-3A
1776	175	" " "	285-CT-285	" " "
1777	"	" " "	325-CT-325	" " "
1778	"	" " "	350-CT-350	" " "
1779	"	" " "	385-CT-385	" " "
1780	200	" " "	350-CT-350	" " "
1781	"	" " "	400-CT-400	" " "
1782	"	" " "	450-CT-450	" " "
1400	250	200 — 220 — 230 —240 v	565-500-425 a side	2 x 6.3V-3A; 5V-3A 2 x 2.5V-3A
1371	300	" " "	1000, 850, 750, 600, 500 a side	

ULTRA-LINEAR

TYPE 931-15: 20 watts.
Prim.: 4500 ohms P.P.
Sec.: 3.7 or 15 ohms.
Resp.: 10-60,000 cps.
Valves: KT.37, KT66. 6L6 etc.
19% Screen Taps.

TYPE 931-8: 20 watts.
Prim.: as 931-15.
Sec.: 2 or 8 ohms.
Resp.: As 931-15
Valves: As 931-15.
19% Screen Taps.

TYPE 921-15: 20 watts.
Prim.: 6600 ohms P.P
Sec.: 3.7 or 15 ohms.
Resp.: 10-60,000 cps.
Valves: 807, KT66, etc.
19% Screen Taps.

TYPE 921-8: 20 watts.
Prim.: As for 921-15.
Sec.: 2 or 8 ohms.
Resp.: As 921-15.
Valves: As for 921-15.
19% Screen Taps

TYPE 916-15: 12 watts.
Prim.: 8500 ohms P.P.
Sec.: 3.7 or 15 ohms.
Resp.: 10-50,000 cps.
Valves: 6BW6, 6V6. KT61, etc.
19% Screen Taps

TYPE 916-8: 12 watts.
Prim.: As 916-15.
Sec.: 2 or 8 ohms.
Resp.: As for 916-15.
Valves: As for 916-15.
19% Screen Taps.

TYPE 949: 12 watts.
Prim.: 8000 ohms P.P.
Sec.: 2, 8, 12.5 and 15 ohms.
Resp.: 10-50,000 cps.
Valves: 6V6, 6BW6. KT61, EL84, etc.
19% Screen Taps.

HIGH FIDELITY

FOR MULLARD "5-10" AMPLIFIER

TYPE 2525 — 12 watts.
Prim.: 8000 or 6000 ohms CT.
Sec.: 8; 2 or 8 ohms 15: 3.7 or 15 ohms
Response: + — 1 db 10-100,000 cps.

SPECIAL HI-FIDELITY +—, 1db 20-40,000 cps
OUTPUT TYPE

TYPE 870 — 6 watts.
Prim.: 10,000 ohms P.P.
Sec.: 2 or 8 ohms.
(for "Rola" 120X)

TYPE 871 — 12 watts.
Prime.: 10,000 ohms P.P.
Sec.: 2 or 8 ohms.

TYPE 872 — 12 watts.
Prim.: 10,000 ohms P.P
Sec.: 3.7 or 15 ohms.

HIGH FIDELITY +—1db 30-15,000 cps
OUTPUT TYPE

TYPE 763 — 15 watts.
Prim.: 5000, 3000 ohms P.P.
Sec.: 15, 12.5, 8, 3.7 and 2 ohms.

TYPE 920 — 15 watts.
Prim.: 5000, 3000 ohms P.P.
Sec.: 500, 250, 166, 125 and 100 ohms

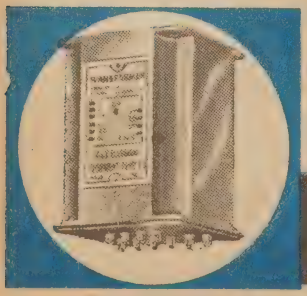
TYPE 897 — 15 watts.
Prim.: 10,000, 8000 ohms P.P.
Sec.: 500, 250, 166, 125 and 100 ohms.

TYPE 896 — 15 watts.
Prim.: 10,000, 8000 ohms P.P.
Sec.: 15, 12.5, 8, 3.7 and 2 ohms.

MEDIUM FIDELITY +—2db 50-12,000 cps

Type	Watts	Primary	Secondary
809	15	500 ohms	15, 12, 8, 3.7, 2 ohms
914	15	5000, 3000 P.P	500, 250, 166, 125 and 106
915	15	5000, 3000 P.P.	15, 12.5, 8, 3.7 and 2
917	15	10,000, 8000 P.P.	500, 250, 166, 125 and 100
918	15	10,000, 8000 P.P	15, 12.5, 8, 3.7 and 2
922	25	8000 P.P.	500, 250, 166, 125 and 100

Type	Watts	Primary	Secondary
891	35	6600 P.P.	500, 250, 166, 125 100, 83 ohms
892	55	3200 P.P.	500, 250, 166, 125, 83, 62 and 50
928	5	7000, 5000 S.E.	12.5, 8, 3.7 and 2
929	10	4000, 2500 S.E.	15, 12.5, 8, 3.7 and 2
930	10	4000, 2500 S.E.	500, 250, 125
932	7	10,000 P.P.	15, 12.5, 8, 3.7 and 2



Victoria: Homecrafts P/L., J. H. Magrath and Co. P/L., Radio Parts P/L., Warburton Franki Motor Spares Ltd. **Sth. Aust.:** Gerard and Goodman Ltd., 196 Rundle St., Adelaide. **Qld.:** A. E. Harrold, 123 Charlotte St., Brisbane; Messrs. Chandlers P/L., Cnr. Albert and Charlotte Sts., Brisbane; Trackson Bros., 157 Elizabeth St., Brisbane. **W. Aust.:** A. J. Wyle P/L., 1064 Hay St., Perth. **Tas.:** Homecrafts P/L., 220 Elizabeth St., Hobart. **N.S.W.:** Factory Reps.: R. H. Cunningham P/L., Meadowbank; United Radio Distributors P/L., 175 Phillip St., Sydney; Homecrafts P/L., 100 Clarence St., Sydney.

A & R ELECTRONIC EQUIPMENT CO. PTY. LTD.

378 ST. KILDA ROAD, MELBOURNE, S.C.1

Telegrams: "ARLEC," Melbourne. MX 1150, MX 1159

two similar receivers with similar loudspeakers. At least two identical channels would be necessary to get the best result. 2. It was not possible in every case to ensure that the phasing of the loudspeakers in the two channels would be the same. 3. The results necessarily depend very much upon the acoustics of the listener's room, on the arrangement of the loudspeakers, and on the position of the listener in relation to them.

"Given reasonably favourable listening conditions, a pronounced stereophonic effect was obtained from some of the recordings. On musical recordings the effect was less pronounced. Listeners using only one channel did not always get an acceptable balance in the musical items.

"Comments received from over a hundred listeners may be summarised as follows: All experienced some stereophonic effect, described as a sense of the orchestra being in the room, or an impression of 'perspective' or 'presence.' About 10 per cent reported that they had a clear impression of the location of the orchestral instruments. About 50 per cent had some difficulty in lining up the two receivers so as to make the non-stereophonic items appear to come from midway between them. (This is the percentage that would be expected if the phasing of the two loudspeakers was random.)

"The B.B.C. has no intention at present of introducing stereophony into the normal broadcasting service, but further experimental transmissions may be made from time to time."

★ ★ ★

Eye Camera

A HIGH-SPEED camera recently installed at Sydney Hospital will enable photographs of the back of the eye to be taken at speeds up to 1/3000th of a second.

The camera — valued at £1,200 — is the only one of its kind in the State.

Specialists in diseases of the heart and bloodstream, as well as eye doctors, will use the camera.

The retina is the one place in the human body where the veins, arteries and fine capillary blood structure can be easily observed.

It will enable doctors to diagnose more accurately and watch the effect of new drugs and treatments.

★ ★ ★

Unfair to drivers

THE Automobile Association, one of Britain's two road organisations, has objected to a police radar plan to detect vehicles exceeding the speed limit.

The instrument, to be used at selected points in London, is a radar speedmeter, an American invention which, by means of a beam from a patrol car, translates waves sent out by approaching vehicles into miles an hour.

An A.A. spokesman said the association's principal objection was that the instrument was unreliable.

They claimed it was impossible to identify a single vehicle from a number travelling past a given point together.

The result would be, it is claimed, that vehicles travelling in convoy would be virtually immune from detection, but the trap would be set for a single car or lorry.

The association added that such "arbitrary discrimination" would not be acceptable to public opinion.

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Vacancies exist for young men up to 19 years of age with the Intermediate Certificate as Traffic Assistants in the Commission's telecommunications centre at Sydney.
Initial duties include recording, sorting and distribution of telegraphic traffic at a commencing salary of £353 per annum for those under 17 rising with age and experience to £822 per annum while earlier higher salary ranges may be attained by qualifying as Telegraphist, Radio Officer or Radio Technician.
These are permanent positions with free or assisted training facilities and Commonwealth Superannuation.

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Vacancies exist in the Commission's Coastal Radio Service for holders of a First or Second Class Commercial Operators' Certificate of Proficiency in Radio telegraphy and Radio-telephony who are capable touch typists.
Successful applicants who are medically fit have the opportunity to serve at stations situated in all capital cities and at other places around the coast of Australia and in Papua/New Guinea.
The salary range is £912-£1092 for holders of First-Class Ticket or £882-£1062 for persons with Second-Class Ticket. Shift work is involved for which extra payments are made, while other allowances are payable at tropical and remote stations up to a maximum of £320 per annum for married officer stationed in Papua/New Guinea or at Darwin.
Hours of duty are 36 per week while annual leave accrues at the rate of from 15 days per annum at southern locations up to a maximum of 30 days per annum at certain northern stations.
Furnished staff cottages at a moderate rental are available at most non-metropolitan locations.
Early permanent appointment which carries right of entry into the Commonwealth Superannuation Fund is available.

APPLY TO:

The Chief Administrative Officer,
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Box 7000, G.P.O., Sydney.
or ring B0544, extension 259, and arrange for an interview.

OTC

An experimental voltmeter making use of the simple 2-transitor amplifier was constructed using a standard commercial 0-100 u A meter.

Transistorised Meter

Transistors are essentially current amplifiers and since they are capable of operating efficiently at low levels, one of the obvious uses for them is as a DC amplifier for increasing the sensitivity of moving coil meters. This article discusses the problems and shows how a simple transistor amplifier can serve as the basis of a very sensitive electronic multimeter.

by Maurice Findlay

NUMEROUS articles describing transistor DC amplifiers have appeared in the technical Press overseas but none appear to have tackled the problems of drift etc. and produced a solution simple enough to serve as a portable instrument competing with the familiar valve voltmeter in sensitivity, ease of operation and reliability.

The author, while a student ot the N.S.W. University of Technology, undertook a project to develop a suitable amplifier and most of this article is based on work done towards that project.

It was considered that the amplifier plus meter should fit in as nearly as possible with accepted multi-range test meter practice. The input terminals of the amplifier should behave as nearly as possible as the terminals of a moving coil meter i.e., the potential between the amplifier input terminals with the indicating meter at zero should be zero and the resistance between the terminals should be reasonably low and as linear as possible.

Development work was carried out on the basis that no special components, not available commercially, were to be used and that the cost was to be reduced to a minimum in order to make the amplifier a practical proposition for a portable electronic voltmeter or multimeter.

Although the project was undertaken mainly with the voltmeter in mind, it was recognised that a precision DC transistor amplifier would find application in biological and medical recording apparatus, telemetering circuits and so on where apparatus employing valves and requiring power from the mains is inconveniently large.

A precision transistor DC amplifier plus moving coil meter may, in many cases, be an acceptable alternative to expensive and fragile suspension type mirror galvanometers.

Since a transistor voltmeter will have applications similar to existing valve voltmeters, it is desirable to examine briefly the characteristics of a typical valve voltmeter and to note the characteristics required of the transistor amplifier in order to achieve comparable performance when used in conjunction with inexpensive meters.

Although more sensitive meters are available, the most sensitive meter movement in good supply and at low cost requires 100 uA for full-scale deflection. The resistance of the coil is usually about 1000 ohms.

THE STANDARD INSTRUMENT

Valve voltmeters are frequently designed with a constant input resistance of the order of 10 megohms and with full-scale deflection ranges between about 3 volts and 1,000 volts. Special probes allowing measurement up to about 30,000 volts for the checking of television picture tube EHT voltages are available. The external probe invariably has an inbuilt high value resistance, making the total resistance on this range considerably higher than 10 megohms—often several hundred megohms.

The intput resistance on the ranges below 1,000 volts is not often made higher than 10 megs. because of the difficulty of making the resistance of switching circuits high enough to cause negligible error under all climatic conditions.

A gain figure such as 10, 100 or 1,000 has the advantage of suiting existing meters and scales.

If an amplifier is designed for a current gain of 10, for example, and used with a 0-100 uA meter the input resistance of the voltmeter will be 0.1 meg. per volt full-scale deflection (10 megs. on the 100 volt range). For a gain of 100 it will be 1 meg./volt, and for a gain of 1,000 it will be 10 meg./volt.

It would appear then that an amplifier gain greater than about 1,000 would not be an advantage except perhaps for the lowest voltage range. However, any gain up to 1,000 would be worthwhile provided it can be obtained with good stability, absence of noise, and so on.

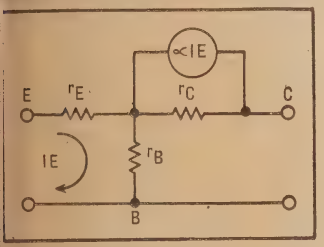
The above discussion assumes DC ranges but the considerations for AC ranges where a bridge rectifier is used are generally similar.

It is not often essential for service work that the reading accuracy of a voltmeter be better than about 5 per cent. The tolerance on inexpensive

meters may be up to 2 per cent of full-scale deflection, to which must be added probable errors of multiplier resistors. Therefore errors of the order of 2 per cent are not likely to prejudice the usefulness of a transistor amplifier in an electronic voltmeter, especially when it offers considerable advantages in terms of sensitivity when compared with the simple multimeter, and cost and portability when compared with the valve voltmeter.

Available transistors are semi-conductor triodes. The three elements are the base, emitter and the collector, these being roughly analogous to the grid, cathode and anode respectively of a triode valve. The transistor differs from the valve in many respects and any anology must necessarily be loose.

Important considerations entering into the design of transistorised equipment are that the transistor usually requires a current rather than a voltage signal source for low distortion and that the elements are very much more interdependent than in the case of the valve.



A small signal equivalent circuit for the common base connection at low frequencies is given here. Transistor characteristics for this circuit have frequently been published, but recently there has been a tendency to regard the common emitter circuit as the basic one. The latter is roughly analogous to the valve in the common cathode connection. The general characteristics of junction transistors in each of the three configurations is given in table form.

From Figure 1 it will be noted that the common emitter circuit is best suited to the meter amplifier application since it provides about the same current gain as the common collector circuit but the input impedance is lower making for a smaller voltage drop if the amplifier is used without multiplier resistors to measure small currents.

TOLERANCES

Transistor parameters which are important in the design of a precision transistor DC amplifier are:

1. Base resistance (rB).
2. Emitter resistance (rE).
3. Collector resistance (rC).
4. Current amplification factor (alpha)
5. DC collector current for zero emitter current (Ico).

Manufacturing tolerances on the above are at least plus or minus 20 per cent. All vary with operating point and temperature. Therefore the calculation of exact gain figures from published data is not possible.

Although all transistor parameters affect the performance of an amplifier, the most significant from the point of view of the present amplifier is the current amplification factor. In the common emitter circuit this has a value between about 30 and 60 depending on the transistor, the operating point and the temperature.

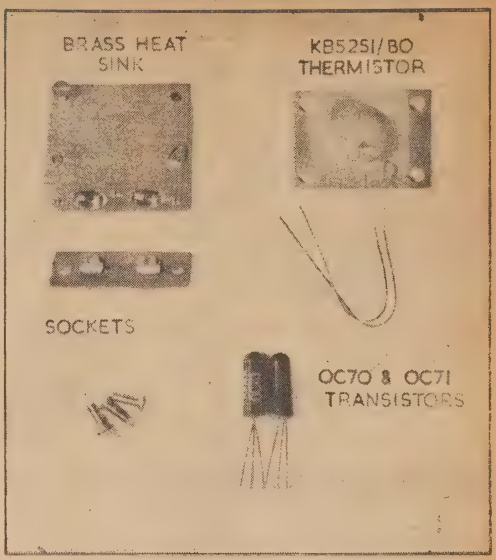


Figure 4: Parts used in the construction of the transistor amplifier. The transistors and the thermistor are maintained at substantially the same temperature by means of a heat sink, in this case made from brass. The transistors fit into holes in the brass block and the thermistor bolts to the side.

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For a given transistor it is relatively constant with variations in temperature and operating point and numerous current amplifier designs which assume that it is, in fact, constant have appeared.

However, measurements described here prove that the variation in current amplification factor with temperature is too much to allow to go uncompensated if the accuracy requirements set out in the introduction are to be satisfied.

MEASUREMENTS

A total of six junction transistors, four type OC70 and two type OC71 were connected and measurements made with the circuit of Figure 2 to determine the relation between current amplification and temperature.

Collector current was plotted against base current with constant collector voltage at temperatures of 20 degrees C, 30 degrees C and 40 degrees C. Unfortunately time did not permit the provision of facilities for making measurements at less than room temperature but the general tendency is clearly indicated.

From the curves of Figure 3, it is observed that at a constant temperature the current gain is very nearly constant for base currents between 0 and —50 uA. However, close observation of the data shows that the current gain is consistently slightly less at collector currents below about 1 mA. (Two of the transistors measured had characteristics differing widely from the remainder and the published data. These may be considered faulty and the curves are not included. However, the current gain was also slightly less at low collector currents.)

There is a marked increase in current gain with increasing temperature. In the case of sample 2, an OC71, the slope varied from 48 at 20 degrees C to 63 at 40 degrees C. This corresponds to a change in current amplification factor of 1.6 degrees approx. per degree centigrade, and is far too great to be tolerated in a measuring instrument.

The increase in current gain with temperature was consistent with all six samples tested, and there it can reasonably be assumed that it is a general characteristic of the fused junction transistor types tested.

NOT ACCURATE

It must be assumed also that many published current amplifier designs do not maintain constant gain with varying temperature.

The slight increase in current amplification factor at higher collector currents may be due to the rise in the base/collector junction temperature due to collector dissipation, which would be consistent with the general increase in current amplification factor with temperature.

To establish this point definitely it would be necessary to use a dynamic method of measurement such that the time taken in making the measurement is small compared with the thermal

☆

Figure 1: A summary of the behaviour of transistors in three possible configurations.

	Common Base	Common Emitter	Common Collector
Current Gain	$\alpha = .98$ approx.	$\frac{\alpha}{(1-\alpha)}$	approx. $= \frac{\alpha}{(1-\alpha)}$
Input Impedance	Low	Medium	High (with required load)
Output Impedance	High	Medium	Variable

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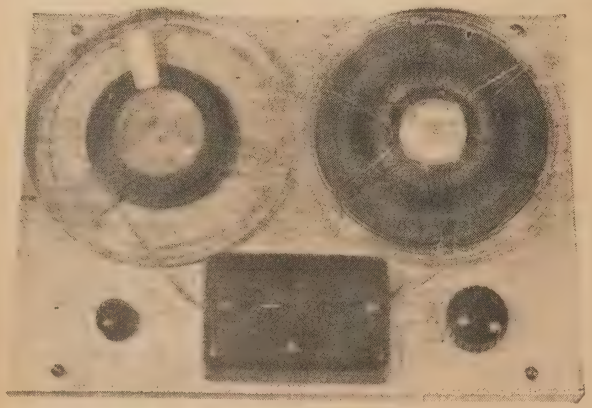

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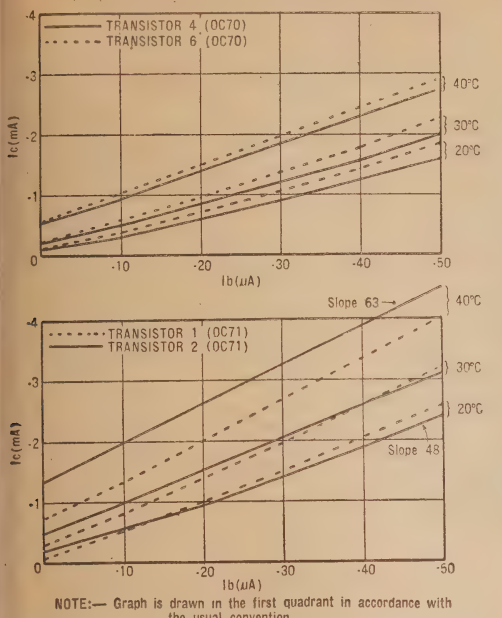


NOTE:— Graph is drawn in the first quadrant in accordance with the usual convention.

Figure 3: A plot of the Ic/Ib characteristic reveals that both the standing collector current and slope of the curve vary with temperature.

GRAPHICAL ANALYSIS OF THERMALLY SENSITIVE SHUNT NETWORK.

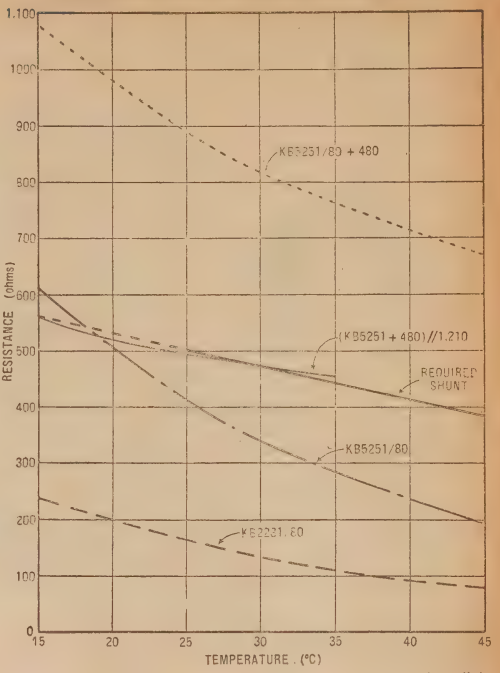


Figure 5: A standard thermistor can be used in a series/parallel combination to approximate closely the required resistance temperature characteristic.

time constant of the transistor element.

Since it is a minor effect compared with the general shift in slope with temperature, for the transistor voltmeter application, it was not investigated further.

The variation in standing collector current (Ico') at zero base current due to the change in Ico with temperature is also clearly indicated by the curves. It was noted that Ico' increases approximately by a constant factor of three for each 10 degrees C increase in temperature.

Unless it is cancelled out by the use of balanced circuits, the change in standing collector current would make it necessary to adjust the zero of a voltmeter frequently and therefore render the instrument a less attractive proposition. Since, however, it is capable of being cancelled and does not affect the calibration after the zero has been set the effect is less serious than the change in current gain with temperature.

TRANSISTOR SELECTION

Zero shift with temperature can be made negligible if the application of the instrument demands by selecting transistors with similar characteristics for use in balanced circuits.

Since the h21' characteristic is virtually straight, matched pairs of transistors can be selected simply by noting two points on the characteristic at constant temperature.

Due to the extreme sensitivity of transistors to temperature, handling before taking readings, should be by the intermediary of some insulated tool, such as a pair of tweezers with felt insulated tips. The preferred method is to place the transistors in a temperature-controlled chamber allowing them to remain long enough for the transistor element to reach the temperature of the chamber.

Depending on the initial temperature difference, periods up to an hour may be necessary. Connecting leads to the transistors for measuring purposes should be such as not to allow appreciable heat conduction from outside the chamber.

The ability of transistors to maintain characteristics at a given operating point and temperature is of interest since this factor determines the methods which must be adopted in order to design an amplifier with good long-term stability.

LONG TERM STABILITY

No information on the subject is available from the manufacturers of the types used and little information of value on long term stability of transistors in general appears in the available references. The data given by Bevitt (see references) where permanent change in characteristics is observed when the temperature is raised to 80 degrees C does not necessarily indicate that any permanent change in characteristics will occur at temperatures under the 45 degrees C limit set by the manufacturers of the OC70 and OC71.

The transistors used in the present experiments were raised to a temperature of 40 degrees C (104 degrees F) at least 12 times and no changes in characteristics were observed.

Most of the faults such as "sleeping sickness," "slow death" and "sudden death" evident in early transistor types were due to water vapour and, in grown junction types, leakage between the collector and emitter across the minute surface path of the base. The OC70 and OC71 are diffused junction types so that the surface path between collector and emitter across the base is long. The element is hermetically sealed in glass and therefore completely moisture resistant.

An amplifier design which depends on transistor characteristics remaining con-

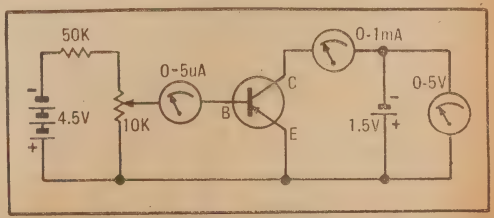
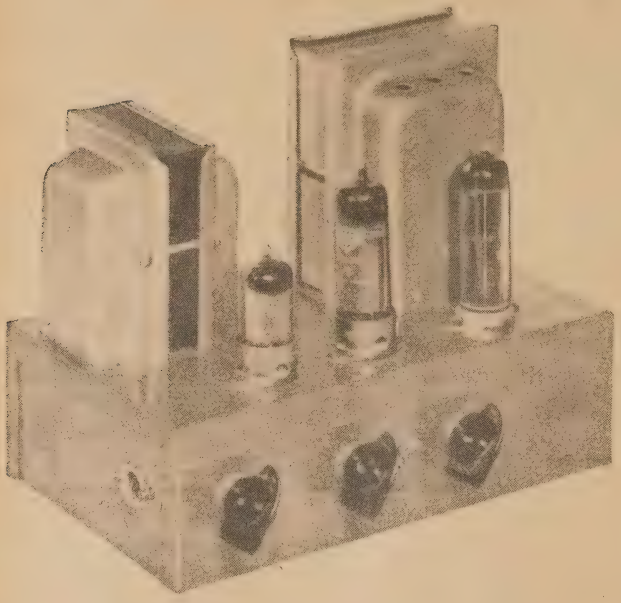


Figure 2: Circuit used for the determination of the transistor characteristics given in Figure 3 above

MULLARD '3-3' FROM U.R.D.



The Mullard '3-3' circuit has been developed from the 3-valve 3-watt amplifier which was designed for those constructors wishing to make a simple amplifier having a reasonably high quality. A few changes to the original design have resulted in improved low frequency stability and in less distortion at maximum output. The '3-3' circuit gives an output of 3 watts at a total harmonic distortion of 1%.

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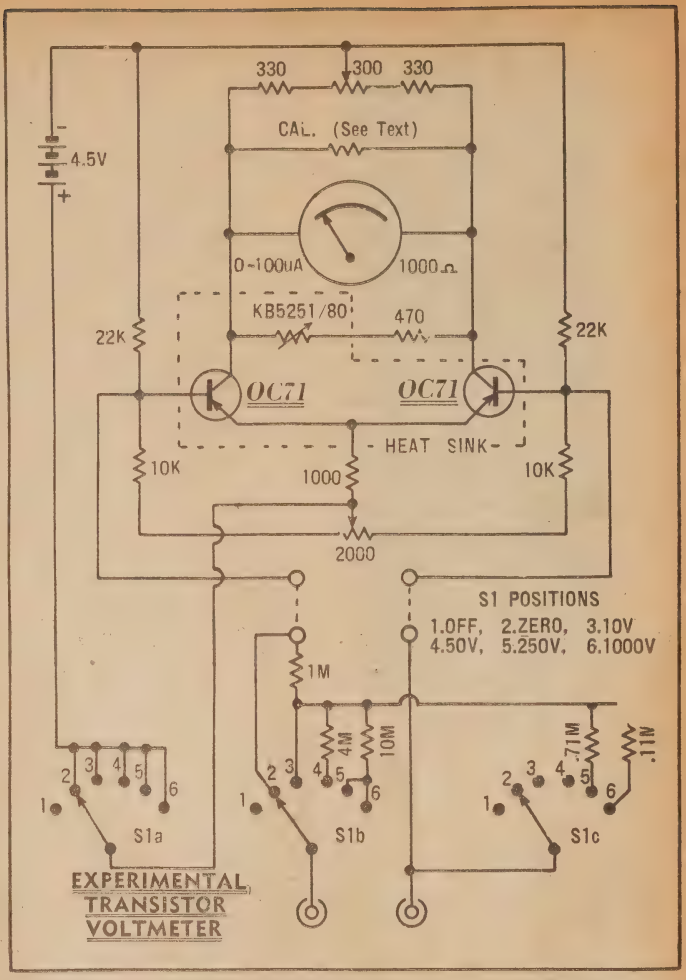
Figure 6: Circuit of the experimental voltmeter. The transistor amplifier, which is the basis of the instrument appears at the top of the diagram.



stant, at a given operating point and temperature, would therefore appear to be justified provided care is taken that the transistors are never subjected to a temperature greater than about 45 degrees C and that they are never overloaded.

From the information on transistor characteristics which appears in the previous section it is apparent that there are at least two basic approaches to the design of transistor amplifier for a measuring instrument.

The simplest depends on the consistency of transistor characteristics and involves the introduction of a temperature sensitive element to compensate for the change in transistor characteristics with temperature. Possible temperature sensitive elements include (a) ceramic resistors which have NTC characteristics approximating 1 per cent to 2 per cent per degree C., (b) "Thermistors" NTC 3 per cent or greater per degree C and (c) finally germanium elements—either diodes or transistors.

The last has the advantage of a thermal time constant equal to that of the element being compensated and therefore is accurate for sudden changes in temperature. However, Thermistors have the advantage of being bi-lateral devices which may allow the use of one rather than two compensating elements.

TEMPERATURE COMPENSATION

A Thermistor may be mounted in intimate thermal contact with a heat sink which is also in thermal contact with the transistors to be compensated. The effective thermal time constant, with respect to changes in ambient temperature, of all heat-sensitive devices in the amplifier may therefore be made long and good compensation achieved.

An alternative approach to the design of a precision amplifier is to provide a basic amplifier with a high internal gain and then reduce the external gain to the required figure by means of feedback. Provided the internal gain is high compared with the external gain, the external gain depends mainly on the constants of the feedback network.

This method has the advantage that slight changes in gain with supply voltage are also compensated. However, it is difficult to apply because it is difficult to make the feedback network independent of changes in transistor parameters.

Finally, the two methods may be combined in an amplifier with thermally sensitive compensating elements, moderate internal gain and moderate feedback

DESIGN REQUIREMENTS

The first and simplest approach offers economic advantages and is therefore worth investigating. Accordingly, an amplifier was designed to have a:

(1) current gain of 10.
(2) work into a 1,000 ohm 100 uA meter,
(3) provide a linear scale to greater than full meter deflection,
(4) maintain stability of operating point with change in temperature.

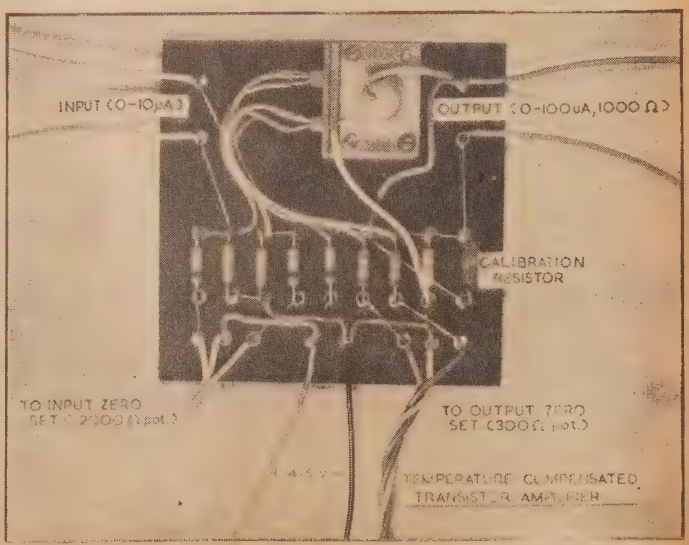


Figure 7: The prototype amplifier. It could be made small enough to fit in a meter case if necessary.

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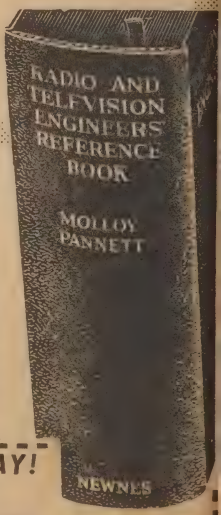

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(5) maintain constant gain with variation in temperature and supply voltage,
(6) have as low an input resistance as possible,
(7) maintain a reasonably constant zero setting under all conditions and
(8) use a single battery supply.

Requirements (4) and (8) dictate a stabilising arrangement consisting of a divider network in the base circuit with series emitter resistor in order to maintain nearly constant collector current. If the requirements are to be met with a reasonably low current drain through the divider network a 4.5 volt supply is necessary.

Requirement (7) is easiest met by employing a push-pull circuit such that the meter is sensitive only to differential currents. The push-pull circuit has the further advantages that the slight change in current gain with operating point, observed earlier, cancels out. Also, there is no degeneration across a common emitter stabilising resistance.

There is a choice between separate divider network has the advantage of the two transistors for stabilisation of the operating point and a common stabilising network with isolating resistors. The number of resistors required is the same and resistor power dissipation is not in question but the separate divider network has the advantage of simplifying the zero setting.

It is necessary to provide a control to bring the indicating meter to zero with the input terminals shorted and a further control to ensure that the bases of the two transistors are at the same potential when the current source has a high internal resistance. The latter can conveniently be made part of the stabilising divider network.

THE METER

Since a meter with a centre tapped coil is not normally available collector load resistors are required. The optimum value is high if meter shunting is required to be low but since some shunting is used to adjust the effective gain, values comparable with the meter resistance are acceptable.

Consider the normal operating temperature as 25 degrees C and the maximum operating temperature at 40 degrees C. From the manufacturers' data the change in Ico from 25 degrees C to 40 degrees C is 20 uA. (The change is much less for lower temperatures.) It is necessary to decide on a permissible change in collector current. A reasonable assumption is that the maximum change be 80 uA making the required stability factor (see references) equal to 4.

It is also necessary to decide on a suitable operating point. From the curves, 0.6 mA/transistor at 2.5 volts is a reasonable compromise between power consumption and maintenance of operation in the linear portion of the characteristic. This takes into account possible changes in supply voltage and changes in Ico due to temperature. The operating point also allows some reserve for variation in transistor characteristics.

From Shea (see references) and where S is the stability factor:

$$R1 = \frac{\alpha(E - IcRL - Vc)}{Ic' - Ico}$$

$$= \frac{.98\,(4.5 - .6 \times 1000 - 2.5)}{\frac{1000}{.5} - \frac{.008}{1000}}$$

where Ico = .008mA at 25°C

$$= 2,450 \text{ ohms}$$

$$R3 = \frac{E(S-1)}{Ic - SIco}$$

$$= \frac{4.5 \times 3 \times 1000}{.568}$$

$$= 23,800 \text{ ohms}$$

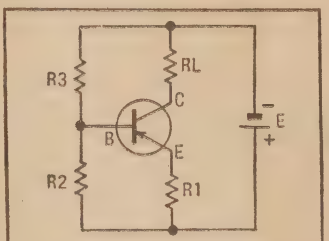
$$R2 = \frac{R1R3\,(S-1)}{R3S\alpha - (S-1)(R1 + R3)}$$

$$= \frac{2,450 \times 23,800 \times 3}{23,800 \times 4 \times .98 - 3 \times 26,250}$$

$$= 14,200 \text{ ohms}$$

From the preferred resistor range it is reasonable to make R3-22K, R2-10K plus resistance necessary for balance control. R1 is common to two transistors and a convenient value for R1/2 is 1,000 ohms.

The basic stabilisation circuit is given below.



Basic circuit for stabilisation of operating point with single battery supply.

A "breadboard" version of the amplifier was constructed and it was confirmed that the actual operating conditions approximated the calculated conditions. The model was placed in the temperature controlled chamber and a decade resistance box wired in parallel with the meter terminals. The resistance of the decade box was adjusted to give an effective current gain of exactly 10 at temperatures from 23 degrees C (room temperature) to 40 degrees C the resistance values being as follows.

Resistance (ohms)	Temperature (Degrees C)
537	23
504	25
471	30
443	35
410	40
390	45

The information is given graphically in Figure 5 together with characteristics of two type "KB" Thermistors (S.T.C. See References) which with suitable shaping networks could be considered as compensating elements. The type KB Thermistor consists of a block of thermally sensitive complex metal oxide mounted on a metal plate and therefore suitable for mounting in intimate thermal contact with a heat sink housing the transistors. The normal tolerance on resistance at 20 degrees C for both types is plus or minus 5 p.c.

It is noted that type KB2231/80 with a series resistance of 330 ohms approximates the desired resistance/temperature characteristic. However, type KB5251/80, which has a higher resistance and temperature coefficient, with a shaping network consisting of a series resistance and an overall shunt resistance allows exact compensation at two temperatures and better overall accuracy.

From the graph (exterpolated) the shunt is required to have a resistance of 560 ohms at 15 degrees C and 470 ohms at 30 degrees C. The resistance of type KB5251/80 at these temperatures is 610 ohms and 340 ohms respectively. The required series and shunt resistance for compensation at 15 degrees and 30 degrees C may be found from the solution of two simultaneous equations.

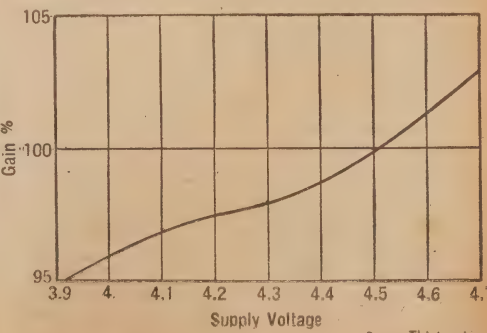
By calculation a series resistance of 480 ohms and an overall shunt resistance of 1210 ohms are required. The calculation is confirmed graphically by adding 480 ohms to the Thermistor characteristic and shunting the combination with 1210 ohms. The deviation from the required shunt throughout the likely temperature range is shown by the graph to be small.

A brass heat sink to which the thermistor could be attached and capable of conveniently housing a pair of transistors was constructed. Necessary zero controls were included in accordance with the circuit (Figure 6).

The value of the collector load resistors was reduced below the original values such that a calibrating resistor of the order of 10,000 ohms was necessary for the gain of 10. This has the advantage that calibration to plus or minus 0.5 p.c. approx. can be achieved by selecting resistors from the standard 10 p.c. series of preferred values. There would be an advantage in using high stability resistor types.

The completed model was subjected to temperatures from room temperature up to 40 degrees C but any change in gain was so small that it could not be detected with certainty.

The terminal voltage of dry cells is likely to vary between about 1.55v and 1.3v per cell during life. Measurements of gain with battery voltages between 4.7v and 3.9 volts were made with the following results.



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Amplifier gain varies slightly with changes in supply voltage. However, it would not be difficult to include a compensating circuit. An adjustment could be made using the meter movement plus a series multiplier as standard.

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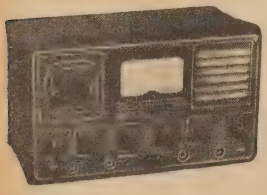

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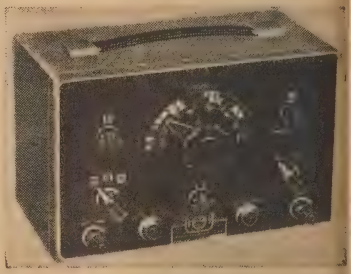

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Although good enough for an amplifier to be used in a service voltmeter, the change in gain with supply voltage is greater than could be desired. A switching circuit to allow the battery voltage to be measured by the meter and a series multiplier directly could be included together with a series rheostat to adjust the supply. This would increase the accuracy at the expense of an extra complication.

The linearity of the scale was checked and shown to be excellent to about twice full scale deflection. At greater currents the amplifier overloads quickly which is an excellent protection for the meter. A gross overload is necessary to exceeded transistor dissipation ratings.

At room temperature 23 degrees C and supply voltage 4.4v the amplifier was switched on and both zero controls adjusted. After 5 minutes the zero drift was 0.05 uA. This may be neglected compared with the FSD of 10uA.

A current of 10 uA applied to the input terminals for 5 minutes caused the entire scale to shift plus 0.3 uA. Exact balance returned after 3 minutes without control correction. The effect is due to unbalanced collector heating and was reduced to about 0.15 uA by filling the heat sink with transformer oil and sealing with a paper gasket.

It is doubtful is the shift could be reduced appreciably further with the OC71's due to the difficulty in making good thermal contact with the transistor element. It is possible that transistors allowing better thermal contact with the germanium will be available in the future.

The total zero shift of the complete amplifier for a temperature change from 15 degrees C to 40 degrees C was 3 uA, referred to the input terminals. Since temperature changes of this order are not likely to occur in a single period of use of the instrument the shift cannot be considered a serious objection. However, it could be reduced by selecting better balanced transistors.

The input resistance of the amplifier increases slightly at full scale deflection and also increases slightly with temperature. At 23.5 degrees C it is 3,800 ohms at small deflection and 4,000 ohms at full deflection. At 40 degrees C it is 4,000 ohms at small deflection and 5,000 ohms at full deflection. A shunt across the input would therefore prejudice the linearity of the scale.

The meter movement can be used directly for the higher current ranges.

At 25 degrees C the power requirement is 4.5V at 1.6 mA. A small flashlamp battery will therefore give good service even if the amplifier is left operating for long periods.

A number of transistor amplifiers depending on feedback for constant gain have been constructed and at least one shows promise of being developed into a form suitable for a measuring instrument. Depending on whether the gain is to be 10 or 100 and other factors, the amplifier may need to contain a total of six or eight transistors. Further, it is most likely that the setting-up procedure for a feedback-type amplifier would be more complicated than for the simple amplifier described.

At the same time, the gain of a feedback-type amplifier may be made to depend on two or possibly four precision resistors and be affected to a negligible extent by the substitution of different transistors and/or varying battery voltages.

The compensated amplifier described gives satisfactory performance in most respects and the simple experimental voltmeter illustrated here was constructed around the basic circuit.

Unless switches of special quality are available, the highest series multiplier which can be used without danger of appreciable error due to the multiplier being shunted by leakage across the switch is of the order of 10 megohms. Valve voltmeters normally have a constant input impedance of about 10 megohms for the same reason.

A three pole switch with at least six positions is required. One pole is used to switch the supply battery and a second pole to switch the series multiplier resistors. In the case of the 250 volt and 1,000 volt ranges, a simple series multiplier would need to be greater than 10 meg. and a third pole is used to switch in shunt resistors.

The shunt is connected across the meter plus series 1.0 meg. multiplier so that the linearity of the scale will not be affected by the change in input resistance of the amplifier at different input currents.

Note that one switch position is provided for zero set. The 300 ohm pot. is set for meter zero with the input terminals shorted and the 2,000 ohm pot. with input terminals open circuit.

While the original amplifier was calibrated for use with a 1,000 ohm 100 uA meter, some of the current commerical 100 uA meters have a resistance of 1,500 ohms necessitating some changes in the compensating network.

Good accuracy can be obtained by calibrating at two points. Start by building the amplifier with a 10,000 ohm, say, potentiometer instead of the 10,000 ohm calibrating resistor and a 1,000 ohm pot. in place of the 470 ohm resistor in series with the thermistor. Set the 1,000 ohm pot. to 470 ohms.

Adjust the 10,000 ohm pot. for correct calibration at about 20 to 25 degrees C. (Normal room temperature). Disconnect one lead of the thermistor and heat the heat sink slowly with a soldering iron until its resistance measures 250 ohms indicating that the temperature is about 40 degrees C.

Connect the thermistor and adjust the 1,000 ohm potentiometer for correct calibration. Check again when the heat sink cools to normal room temperature and adjust the 10,000 ohm pot. It should require only a small amount of adjustment but if it is found to be appreciably off, another check at the higher temperature would be desirable.

Measure the resistances of the pots., and insert fixed resistances of the same value when it should be found that the calibration holds within very close limits over the entire temperature range.

The expansion of the instrument into an electronic multimeter with resistance, current and AC ranges is a separate matter. However the scope of such an instrument in making measurements around high resistance circuits in radio and television receivers would be very much wider than that of an ordinary 1,000 OPV meter. For example, with a 15 volt battery it would be possible to obtain a readable deflection on the resistance scale with a 100 megohm resistor as against only a 1 meg. resistor with a conventional multimeter.

☆

Meter deflection is linear with respect to input current up to about twice full scale of deflection. The overload characteristic provides excellent mechanical protection for the meter movement.

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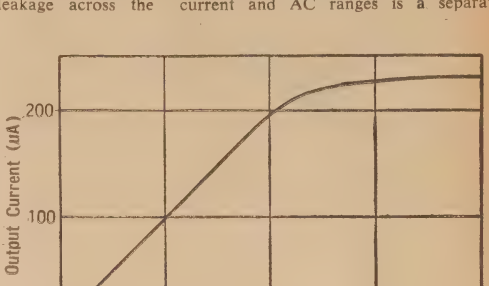

REFERENCES

Mullard "Transistors for the Experimenter," August, 1956. Circuit 14: Sensitive DC Voltmeter. Circuit 15: Transistor Voltmeter. Circuit 16: EHT Voltmeter.

Neale, D. M. and Oakes, F., Transistor DC Amplifier, "Wireless World," November, 1956, P. 529.

Queen, I., Ultra-Sensitive Transistorised Meter, "Radio-Electronics," November, 1955, P. 63.

Philips "Transistors, Germanium Diodes and Silicon Diodes."

Johnson, G., Transistor DC Amplifier, "Wireless World," January, 1955, P. 31.

Bevitt, W. D., "Transistors Handbook."

Shea, R. F., "Principles of Transistor Circuits."

Standard Telephones and Cables P./L. "Valve Data Handbook."

Slaughter, D. W., Feedback Stabilised Transistor Amplifier, "Electronics," May, 1955, P. 174.

Treharne, R. F., A transistor DC Amplifier for Telemetry, WRE Tech. Memos. TQD 7 and TQD 8.

Volkers, W. K. and Pedersen, N. E., The "Hushed" Transistor Amplifier, "Tele-Tech and Electronic Industries," December 1955, January and February 1956.

Campbell, E., Transistorised Meter Sensitiser, "QST," November, 1957, P. 34.

Bernard, W. B., A Transistor Galvanometer Amplifier, "Radio and TV News" February, 1958, P. 43.

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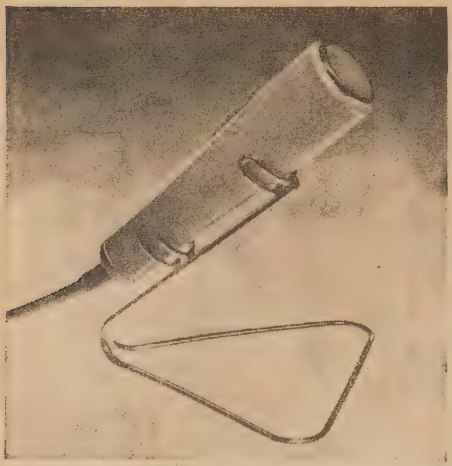

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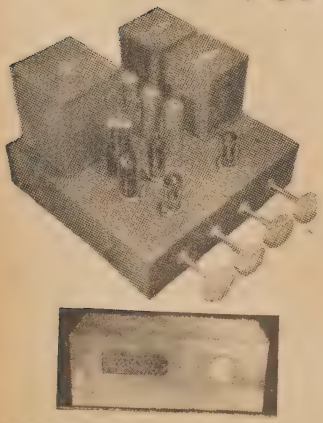

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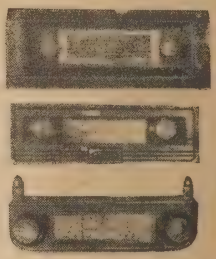

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FROM THE SERVICEMAN WHO TELLS

Picture tube failure is a subject best avoided with TV set owners, who are understandably touchy about it. However, when THEY raise this point, the serviceman can introduce a happier note by pointing out that many picture tube faults can be effectively and economically repaired. Naturally, he will need to know something about the subject himself.

JUST when is a picture tube worn out?

This is a question which we will have to consider quite seriously in the not-too-distant future. Picture tubes are expensive items, and every TV set owner —or prospective owner—invariably expresses the fear that this vital component will fail prematurely.

While manufacturer's guarantees and insurance policies help to take some of the sting out of this fear, any owner is going to feel a good deal happier if he knows that many faults can be repaired, and that his own particular serviceman has the necessary "know how."

COLLECTED INFORMATION

I have been gathering as much material as possible on this subject over the last few months, mainly from overseas technical journals, in anticipation of the need in this country, and a brief survey of my findings may be of value to other servicemen. I must emphasise that, so far, I have not had an opportunity to put any of these ideas into practice.

To date I have collected references to five different repairable faults, varying from those which are almost 100 per cent effective, to those which need a good deal of luck but are worth trying nevertheless. They are as follows: heater-cathode short, internal shorts other than heater-cathode, open circuit in the base pins, open circuit internally, and low emission.

Looking at this list, the most obvious point is the fact that none of the faults is peculiar to picture tubes; all of us have encountered these same faults many times in the humble receiving valve, whose usual fate is to be consigned to the rubbish bin.

While many old-timers may remember some of the tricks employed in the early days of radio (when valves cost, comparatively, many times what they do today), and to a lesser extent during the war when many types were hard to replace, it is quite true that there is generally no future in trying to repair ordinary valves.

PICTURE TUBE PROBLEMS

Sometimes an obvious dry joint in a base pin may be worth repairing, but anything more elaborate than this would normally cost more than fitting a new valve—and be a good deal less convenient.

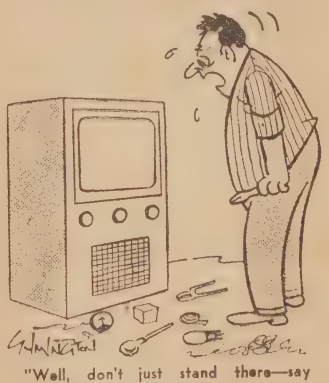
But a picture tube is a different matter. It costs more pounds than a valve does shillings, and any reasonable dodge which promises to prolong its life by as little as six months is usually worth trying. In many cases the repair may be permanent, while others may last anything up to two years.

And believe me, any serviceman who puts off the evil day for two years is going to be the white-haired boy in any household. What's more, the neighbours and friends will certainly be told about your magic touch.

Coming back to the faults I have listed; let us see what appears to be standard practice overseas in such cases.

First, the heater-cathode short. Most receivers feed the video signal to the picture tube by way of the cathode, as well as applying a positive voltage from the brilliance control. As a result, this fault will remove all, or nearly all, the picture, at the same time possibly causing the raster to run at full brilliance.

In this case the cure is not hard. Although the heater is at chassis potential as a matter of convenience it is not essential that this be so, at least as far as the picture tube is concerned. In fact, there is no reason at all why the heater should not "float" at a potential determined by the cathode or the signals applied to it.



"Well, don't just stand there—say something!"

This is done by simply fitting an isolating transformer; a 1-to-1 unit with sufficient insulation between primary and secondary to withstand the normal cathode voltages. The primary goes to the existing heater line, the secondary to the picture tube heater; and, presto! the short is no longer of any consequence.

A feature of this repair is that it is normally quite permanent, while the transformer may be left in place even when a new tube is fitted, thus rendering the set virtually immune to this type of trouble.

The heater and cathode are not the only elements which can short inside the tube, almost any other combination being theoretically possible. In practice it usually occurs between adjacent elements, such as the cathode and control grid, the control grid and grid No. 2, and so on.

We cannot make any circuit modifications to take care of these shorts, since it is not possible to isolate the appropriate circuits as we can with the heater. Instead, we must get rid of the fault itself.

Fortunately, most such faults are due to fine particles of foreign matter which become lodged between the elements concerned rather than one element actually touching the other. The foreign matter may be a particle of cathode material, a sliver of metal from one of the elements itself, or a particle of something which really is foreign in spite of the strict supervision during assembly.

BURNING OUT

The accepted method overseas appears to be that of "burning out" such particles by the application of a fairly high voltage between the two elements. A common and convenient source is the plate of the line output valve, where voltage peaks of several thousand are available.

One of the offending elements should be earthed and the high voltage applied to the other. A lead with a probe at one end and a clip at the other is usually used to pick up the voltage at the plate and apply it to the pin. Both lead and probe should be of high quality insulation.

This repair should also be permanent in most cases, although there is always a small possibility that the offending particle may not be completely destroyed and remain in position to cause the same trouble again if subject to vibration.

DRY JOINTS

Our old friend, the dry joint in the base pins, calls for little comment. As with a valve it is mainly a matter of applying heat, flux, and solder in fairly liberal quantities to the offending pin, and if the tip of the connecting wire can be bared and cleaned, for no matter how short a length, so much the better. Usually, however, one must depend on the flux to do the cleaning.

While it may be possible to do the job with the picture tube horizontal, it is often better to have it face down. In most cases the entire set can be turned over, rather than take the tube out.

Open circuits inside the envelope are quite a different matter. In fact, at first glance one would be inclined to give that one best. However, it seems that the demand has been great enough overseas to justify the development of special equipment to deal with even this situation.

Unfortunately, my only reference to the instrument is written in a style which is quite popular in "overseas" magazines. It says a lot, but tells very little; apparently in an effort not to be too technical. Even the name doesn't help much, it being referred to simply as a "picture

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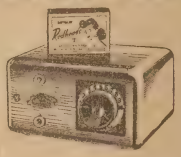

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HOMECRAFT'S *FAST* DESPATCH SERVICE

ube fixer" — a nice general term which neans precisely nothing.

However, from the few facts quoted t seems fairly obvious that the device s an RF heater of some kind, its main ob being to heat the metal parts inside he envelope. This, in turn, appears to e aimed at expanding the metal so that he broken portions may be brought to- ether — assuming the break is not too reat. Further assistance is provided by apping the neck of the tube gently dur- ng the heating process.

AN RF "WELDER"

In addition an RF voltage is applied cross the break (the exact method is ather obscure) apparently with the idea f generating sufficient heat at this point o weld the two portions together. Un- ortunately it is not clear just how hot he elements become initially, or whether his heating effect is supposed to help he welding, or merely expand the metal arts to make them touch.

Naturally, the whole success of the cheme depends on being able to bring he broken parts together, even momen- arily, much as we used to do with old ashioned light globes to get a few more weeks life from them. Unfortunately, he rigid construction makes this very difficult, and the chances of a cure are given as less than 50 per cent.

Even so, there would be nothing to ose and everything to gain by trying t.

Finally we come to the most common fault of all; the one that must befall all ubes eventually — loss of cathode emis- ion. There appears to be two accepted methods of tackling this, one aimed at rejuvenating the tube, and the other em- ploying operating conditions which offset he reduced efficiency.

The rejuvenation process is a hark back to the early radio days when the thoriated tungsten and oxide-coated cathodes first appeared. One of the claims made for these cathodes was that they could be rejuvenated in some cir- cumstances by the application of in- creased heater or filament voltages for short periods.

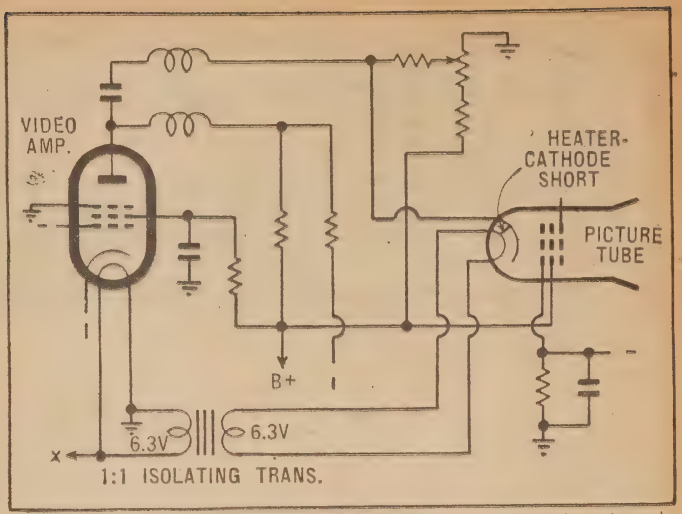
The theory behind this is that it is often only the outer surface of the emitting surface which is at fault, due either to exhaustion or to poisoning by minute quantities of gas inside the en- velope. In such cases it may be possible to bring a new layer of active material to the surface and thus give the cathode a new lease of life.

TYPICAL FIGURES

In the case of the thoriated tungsten cathode (hardly ever used these days for receiving valves) the fresh material (thorium) is contained within the tung- sten in the form of thorium oxide. Typi- cal rejuvenation figures are 30 per cent overload for 10 minutes, followed by normal running for one hour. All other electrodes to be inactive during these periods.

In the case of the oxide-coated cath- odes, the fresh material is expected to come from the thickness of material be- low the surface and the method of achieving this is similar, i.e., some form of planned overload.

Unfortunately, I have been unable to discover any very exact details of the degree and duration of the overload, suggestions ranging from 10 to 30 min- utes and up to 100 per cent overload. What is more, I have always had the impression that the scheme was one of



An isolating transformer will allow a TV tube to continue in use with an internal heater—cathode short circuit.

those things which was never very suc- cessful in practice. The few times I tried it with early receiving-type valves it proved completely worthless.

Maybe I am biased, or maybe the whole thing is simply a carryover from thoriated cathode techniques and is based on false reasoning anyway. If any fel- low servicemen have any comments to offer I would be happy to hear from them.

The other scheme seems to be a far more logical approach and, as far as I can discover, has been used very suc- cessfully overseas. It simply overloads the heater permanently, by a carefully chosen amount, and makes it function more or less by brute force.

OVERLOAD TREATMENT

The overload may be anything from 15 per cent to 25 per cent, depending on the condition of the cathode, the lower value being selected if it is suffi- cient. Then, when this is no longer ade- quate, a further increase can be made, still further prolonging the life.

And what about the poor old heater? How does it take to such drastic treat- ment? Well, the first point to appreciate is that the tube has "had it" anyway, so we have very little to lose, even if the heater fails after only a few months. On this basis alone, the experiment would usually by justified.

In fact, however, the heater seems quite capable of taking such overloads, advocates of the idea claiming that they are rated at 100 per cent above the nor- mal figure. While this may be a little optimistic, there seems little doubt that they are quite happy to chug along al- most indefinitely on a 25 per cent over- load.

(This is not the same as saying that a new valve—or picture tube—can be run with 25 per cent overload without limit- ing its life. Heater overload is one thing, while cathode overload is quite another. Continuous over-rating of the heater, even though it doesn't burn it out, can result only in shortening the life of the cathode.)

Coming back to the more practical aspects, there appear to be a number of transformers available overseas (known as "booster" transformers) designed to provide the necessary increased heater voltage. They are a simple step-up unit, connecting to the 6.3 volt line on one side and delivering a selection of voltages on the other. A 15 per cent increase would give 7.25 volts, and 25 per cent would be 7.9 volts.

Reports from overseas suggest that this scheme is almost always successful to some extent and sufficient to justify the cost of the transformer. In some cases picture tubes are still going after two years on the higher voltage—and, ap- parently, have plenty of life in them yet.

As far as I know there are no com- mercial transformers available in this country as yet, but they will doubtless appear when the demand occurs.

However, in some cases they may not even be necessary. A few sets operate the picture tube filament from a high voltage source (about 20 volts) through a dropping resistor to minimise current surges at the moment of switching on. In this case it would be necessary only to reduce the resistor value slightly to achieve the same effect.

TELL THE MAN!

(Note: In such a case, adequate indi- cation should be left somewhere on the chassis to this effect. Otherwise another serviceman may replace a picture tube without restoring the correct resistance, resulting in serious overload and short- ened life.)

So there it is: I suggest you keep these ideas in mind as well as keeping a sharp lookout for any additional information on the subject. Any that I find will be duly passed on.

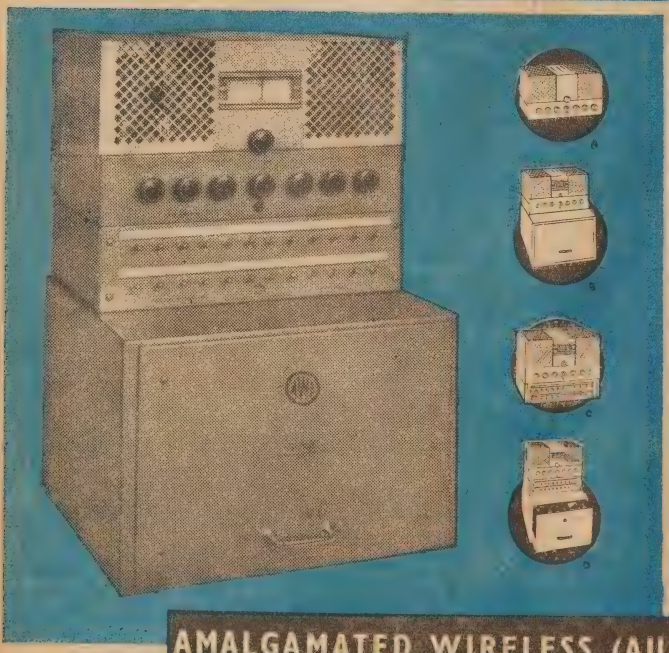
From the service bench I have a story about a humble mantel set, but one which proved quite tricky just the same. (In these days when we are striving to acquaint ourselves with all the tricks of TV sets we must not forget that radio sets can still turn on some pretty good acts.)

This one was suffering from quite a

FOREMOST IN SOUND

AWA

ADDRESS, RADIO AND RECORD PLAYING SYSTEMS



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common fault: the failure of the local oscillator at the low frequency end of the band. The only difference being the owner's complaint that its behaviour was rather erratic; sometimes it would work over the whole band, sometimes only 2FC would be lost, and at other times stations would be missing as far down as the middle of the band.

Without anything more definite to work on, I was prepared to put this down to a combination of a sick converter valve—one that was just managing to oscillate and no more—and severe line voltage variations. As it turned out, I was wrong on both counts.

On the bench the set refused to play 2FC but seemed to perform reasonably well otherwise. I was not able to detect any erratic performance at this stage.

VALVE OK

Fairly naturally I checked the valve first. In the tester it showed "good" without any doubts, so I fished out a spare one I knew was good and tried that as well. It behaved much as did the original, suggesting that the latter really was "good" and that I would have to look further afield.

At this stage I connected the 0-1 milliamp meter in series with the earthy end of the oscillator grid resistor, to check just how well it was oscillating when it did function.

Although this figure will vary with the actual frequency involved it is usually around the 200 to 300 micro-amps mark if all is going well.

In this case the best I could get was about 60 micro-amps; a clear indication that, even when it was oscillating, it was struggling hard. That much established, the next thing was to find out why.

In the hope that vibration might provide a clue I went over each component with the butt end of a screwdriver, keeping one eye on the grid current meter while I did so. This test proved completely negative.

I checked the voltages applied to the valve and these all seemed to be within normal tolerances and certainly not far enough out to cause such a marked drop in performance. At this point I began scribbling little circuits of oscillator stages on scraps of paper and asking myself what would be the next most likely component.

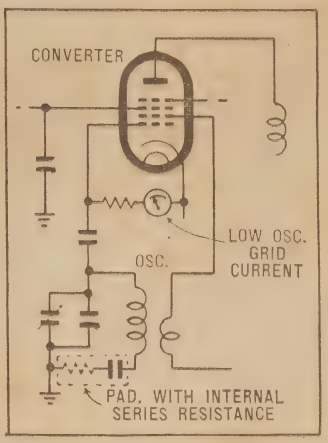
The coil could be faulty, of course. It wouldn't be the first time a spot of corrosion had produced a high resistance connection in a coil, with dire results, whether an oscillator coil or any other type. Using the low ohms range of the meter I carefully measured both windings. Each measured no more than a few ohms and, what was more important, I could detect no sign of variation in the reading, even when I applied pressure to the terminals.

COMPONENT CHECK

Next I measured the oscillator grid resistor; it read well within tolerance. I checked the 50 pf grid coupling capacitor on the bridge; it showed normal value and no measurable leakage. Finally the .1 paper bypass on the HT side of the oscillator coil was taken out and checked. It, too, measured normal.

So now what? I had checked the valve and its voltages, the coil, the grid resistor and the coupling and bypass capacitors. All seemed O.K. What was there left? As far as I could see there was only the tuning capacitor, the trimmer across it and the padder.

Meanwhile some vague memory was stirring itself in the back of my mind. Somewhere, some time, I seemed to remember a colleague had had a similar



Unwanted series resistance in this padder killed the oscillator section of this converter.

problem and that it had finally been cured by changing the padder, though he never did find what was wrong with it.

On an impulse I picked up a 500 pf mica that was lying on the bench and held it in place across the padder. The grid current immediately jumped to somewhere around the 250 micro-amp mark, and receiver noise level also rose. Naturally this would have put the oscillator a long way off frequency, but it did indicate a possible source of trouble.

It didn't take me long to fit a replacement padder, and as soon as the set warmed up again I knew I was right, for the grid current rose to nearly 300 micro-amps, and there was no sign of it dropping out at any point.

Satisfied that the set was O.K., I turned my attention to the padder. Checked on the bridge it measured almost "spot on" the 425 pf marked on it. Next I checked it for leakage, but could not get as much as a flicker out of the neon lamp. If there was any leakage there, it was certainly too high to be of any consequence.

Yet there was obviously something wrong with it, as evidenced by the fact that it would not work in a practical circuit. And it's rather disconcerting to realise that a simple device like a mica capacitor can have a fault which cannot be detected with what is normally considered to be adequate test gear.

But work must go on, and I couldn't afford to waste too much time in meditation and lament at this stage. So I simply put the offending padder aside and went on with the job of final checking the receiver and fitting it back in the cabinet. The solution to the problem would have to wait.

It was not until several days later that I was able to tackle it again; and then it was mainly because a colleague had dropped in to pass the time of day and discuss some business matters. I took the opportunity to relate the story to him, and enquire whether he had ever had a similar experience.

"No," he replied, "but I have heard of it. As far as I can see, if it isn't capacitance change—which would show up in the tracking anyway—and it isn't leakage capacitance, the only thing left is series resistance."

I had to admit I hadn't thought of that one—to the extent that I had thought about it at all—but now that it had been suggested I had to admit that it did seem logical. After all, the padder is a vital portion of the tuned circuit and any effective series "R" would damp the circuit severely. More than that, such a condition might be very hard to detect by ordinary means.

Then my colleague made another suggestion. Pointing to a set upturned on the bench, he asked:

"Is that set working?"

BRIGHT IDEA

When I assured him it was, he went on:

"Well, why not connect some resistance in series with the padder and see what happens? It won't take long."

It seemed a reasonable suggestion, so I switched the set on and commenced gathering up a few likely values of resistance. One of the first was a 1,000 ohm, and this seemed a good round figure with which to start, so I soldered it in series with the padder.

There was no doubt about the effect it had. The oscillator flatly refused to function anywhere but at the high end of the broadcast band, providing convincing proof that very little series resistance would be necessary to wreck a set's performance. What was even more interesting was the precision with which we were able to vary the frequency at which the oscillator cut out simply by selecting suitable values of resistance. Even a couple of hundred ohms was sufficient to affect the low frequency end.

In the light of this we both agreed that there seemed little doubt that this was, in fact, the fault in the padder. Also that a faulty connection between the pigtail and one set of plates would be the most likely cause, particularly as such a resistance could easily change appreciably with changes in temperature.

HARD TO DETECT

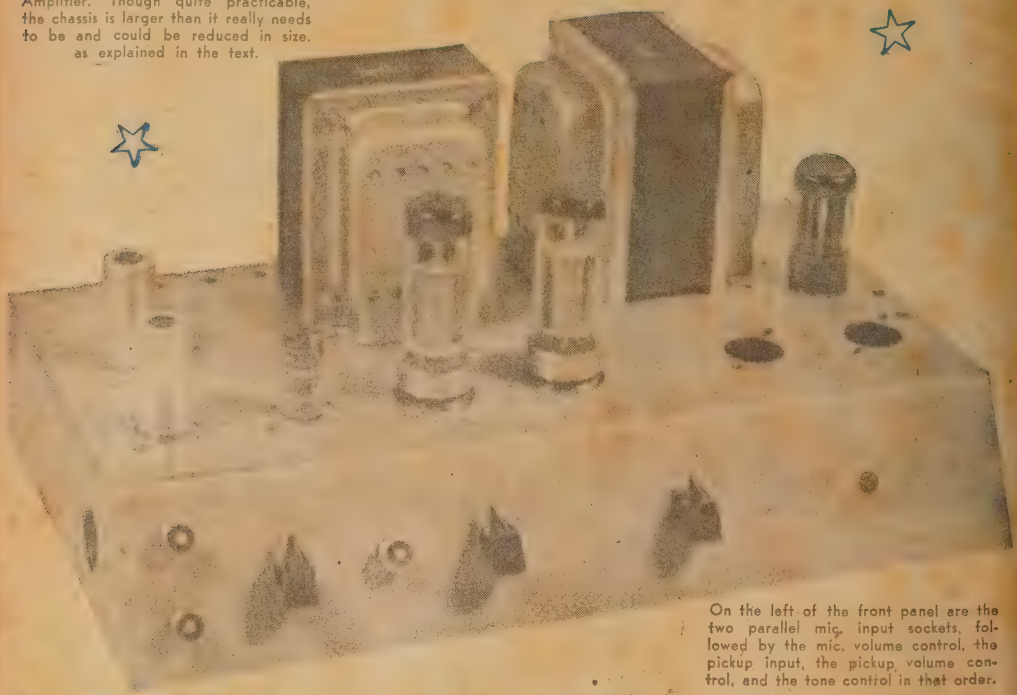
I tried checking the capacitor-resistor combination in the R/C bridge but, as I expected, it registered as perfectly O.K. One of the main reasons for this is the fact that the test is made at 50 cps, whereas the unit would actually work at 1 Mc and higher.

At 50 cps a 400 pf capacitor has a resistance of something like 12 megohms, so that a series resistance of a few hundred ohms would be negligible and virtually impossible to measure. However, at 1 Mc the reactance is only about 300 ohms, so that a series resistance such as we are considering would be quite serious.

Unfortunately, this still leaves us with the problem of how to detect such series resistance, and I'm afraid that there does not seem to be any easy solution to that one. Substitution, while noting the grid current, seems to be the most practical approach and may be perfectly adequate provided we realise that this kind of fault can exist.

Which, after all, is half the battle with most service faults and is my main purpose in passing the story, on to others who may strike this trouble.

So be on the lookout for sick padders.



For purposes of development, the amplifier was built on the chassis which originally carried the 40-watt Factory Amplifier. Though quite practicable, the chassis is larger than it really needs to be and could be reduced in size, as explained in the text.

On the left of the front panel are the two parallel mic. input sockets, followed by the mic. volume control, the pickup input, the pickup volume control, and the tone control in that order.

A 35 Watt Amplifier For P.A.

Here's a project which should be of special interest to many of our readers—a modern 35-watt public address amplifier. It features high gain, mixing facilities and a multi-tapped output transformer to suit a variety of speaker line impedances.

by Philip Watson

IT is some time since we made any reference to the subject of public address amplifiers and re-statement of the general requirements may be of interest to newcomers in this field.

It is possible to do a P.A. job with almost any powerful amplifier, plus a microphone preamp. stage but it doesn't follow that the job will be done well or cheaply or conveniently. A public address amplifier is a special "breed," distinct from the domestic variety.

POWER OUTPUT

Power output is a major consideration, because the very use of the gear presupposes a fairly large audience in a hall or in the open air. The audience may be quiet or noisy, according to the activities of the moment.

This might be accepted as an argument for building a single very large amplifier, able to meet all conceivable power requirements and, indeed, it is. However, it takes no account of the fact that a very powerful amplifier is also likely to be very costly to buy or build, heavy to carry around and possibly more prone to trouble because of the higher voltages and currents throughout.

There is the further complication that a very large amplifier is not economical to operate from a battery-inverter supply, should this ever be necessary.

The wise course is to assess the job or jobs for which an amplifier is likely to be required, consider cost and weight factors and choose accordingly.

In the light of the foregoing, P.A. systems can well be subdivided into about four main classes.

Smallest and cheapest is the single-pentode 4-watt type of thing, which can barely lay claim to the description "public address." Unless it is used with a directional horn speaker, the acoustic power available is not much more than the unaided voice.

However, an amplifier of this type can maintain the said power indefinitely —without getting a sore throat—and is very useful for relaying speech into anterooms, for paging and so on.

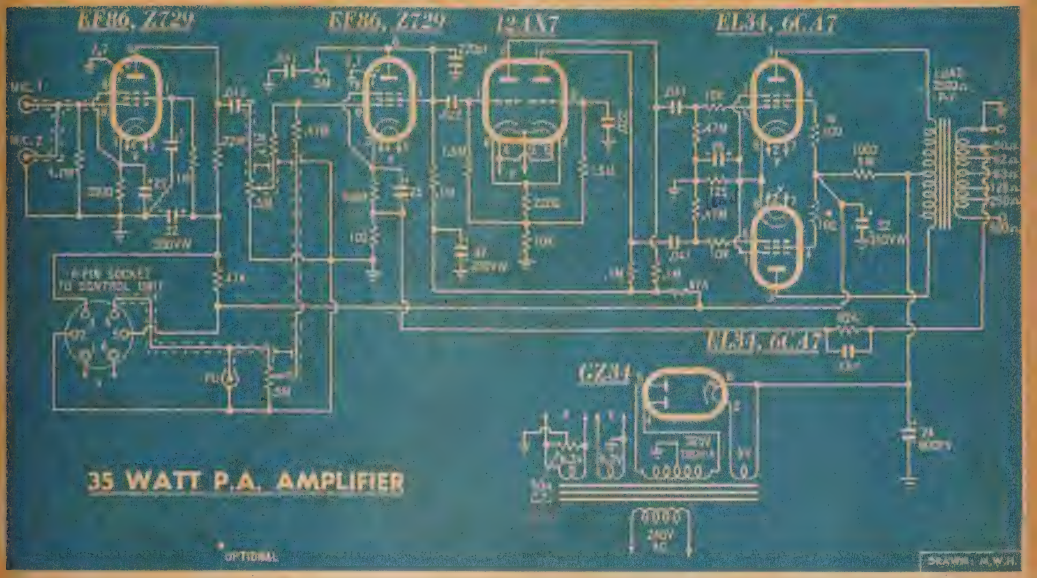
A second class of amplifier has an output of about 10-15 watts, being designed around "receiving type" valves and components. Such an amplifier is normally compact, easy to build and capable of useful speech reinforcement.

OVERLOAD DANGER

However, there is usually very little margin between average operating level and overload and the operator has to watch mic. placement and volume setting very carefully, in consequence.

A third type of amplifier has an output in the 30-50 watt region, using heavy duty power equipment and large

CIRCUIT USES EL34'S IN CLASS AB OPERATION



The circuit is quite straight forward, and follows standard practice. Note the 6-pin outlet socket, with HT supplies for either a control unit or tuner. The cathode coupled phase inverter provides a useful amount of gain, making the overall gain of the system quite high.

output valves without, however, going into the complications of fixed bias, regulated HT supply and possibly Class B2 operation. An amplifier of this type will handle most P.A. jobs without distress.

Last but not least are the really big amplifiers, using very heavy power equipment and large output valves under maximum conditions. In general, such amplifiers are only necessary for big outdoor gatherings, country shows, sports meetings and such like

So much for power output. On the subject of reproduction quality, the standards do not need to be quite as high as for specialised domestic listening, nor the hum level quite as low.

DISTORTION

Obvious distortion must be avoided, of course, but there is no point in spending money to obtain near-perfection from the amplifier, when reproduction will be limited anyway by microphones and speakers of strictly average quality

And what of the input facilities, tone control and such like? Most technicians have "pipe dreams" at some time or other about P.A. systems with multiple inputs, mixing and cueing facilities and complex tone controls. Some even build them up!

In the hard world of reality, the result may be splendid for one particular job but a decided nuisance for everything else! It's larger than necessary and it can't be left in the hands of an unskilled operator without a lengthy dissertation on what all the knobs are for.

By and large, most ordinary P.A. jobs can be handled by one or at most two microphones and one pickup, with mixing facilities. A simple top-cut tone control is handy also to temper some records and voices and as a possible aid against acoustic feedback in adverse situations.

If more channels and/or more extensive tone compensation is required, there is good argument for providing the extra facilities in a separate mixer panel, which can be taken to a special job along with extra microphones, cables, turntables and so on.

Last but not least, there is the output circuit to consider. In a modern domestic amplifier the output transformer is mounted on the chassis, feeding the speaker through extended leads running to the voice coil.

This scheme is quite adequate for domestic listening, where the leads can be kept short enough for their DC resistance to be much lower than the voice coil impedance. For public address amplifier work, quite long speaker leads are sometimes required and lead-loss can be significant, particularly when feeding into single or parallel 2-ohm voice coils.

There is good argument, therefore, for equipping all larger public address amplifiers with an output transformer having a 500-ohm secondary winding. Leads can then be run without significant loss to

PARTS LIST

1 Chassis to suit, see text.
1 Power Transformer 325V-325V, 180 mA. 6.3V 4A. 6.3V 4A. 5V 2A. PF1335 or similar
1 Output transformer. Prim. 3500 ohms. Sec. 500 ohms tapped OPM 12 or similar

VALVES

2 EL34
1 12AX7
2 EF86
1 GZ34

SOCKETS

1 Octal (Optional type)
2 Miniature 9 pin with shield
2 Octal (Amphenol Replacement Type)
1 Miniature 9 pin plain
1 6 pin
3 Single contact mic. plugs and sockets type C/1/02M and C/1/01F or similar

CAPACITORS

1 32 mfd 350VW electrolytic
2 32 mfd 300VW electrolytic
3 25 mfd 25VW electrolytic
1 24 mfd 600PV electrolytic
1 .1mfd 400V paper
4 .047 mfd 400V paper
2 .022 mfd 200V paper
1 220 pf mica or ceramic
1 33 pf mica or ceramic

RESISTORS

1 4.7M ½W
1 1M 1W
4 .47M ½W
3 .1M 1W
2 47K 1W
1 3900 ohms ½W
1 2200 ohms ½W
1 100 ohms ½W
1 1000 ohms 5W
2 1.5M ½W
3 .5M potentiometres
1 .22M 1W
1 82K ½W
3 10K ½W
1 3300 ohms ½W
1 125 ohms 10W
1 50 ohms 5W centre tapped

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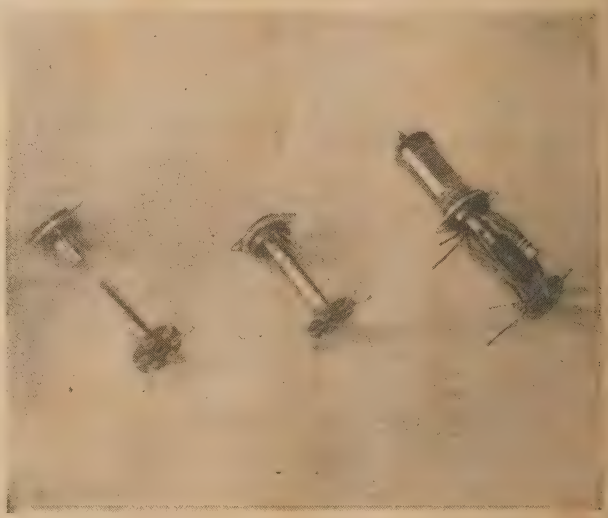

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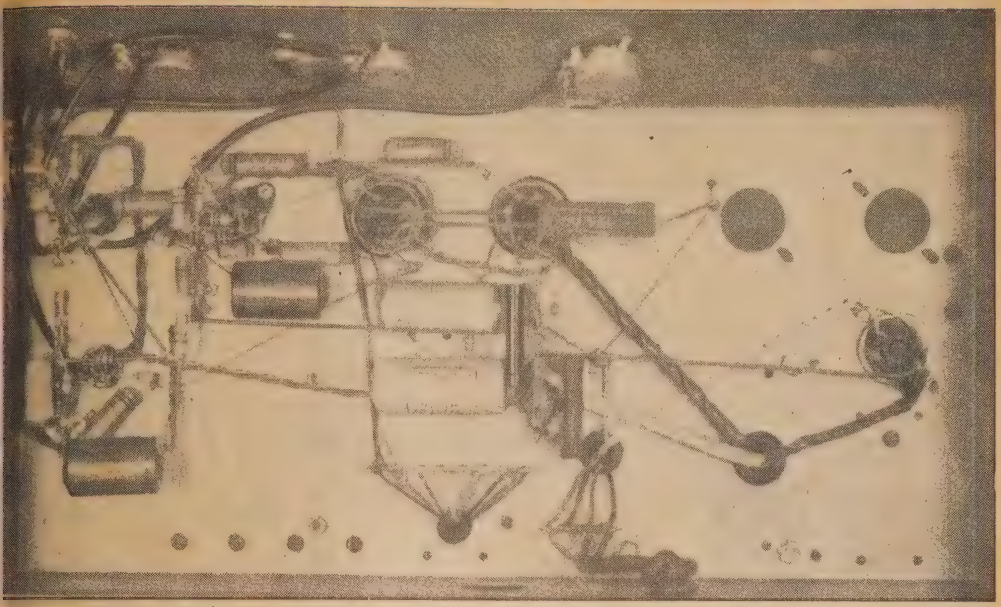
UNDERSIDE PICTURE SHOWS WIRING AND LAYOUT



Here we see the power transformer on the right, the output transformer in the centre, and the two EF86's on the left. The socket hole in the rear of the chassis may be used to accommodate a speaker socket if the speaker connections are to be a fixed combination.

stant speakers, a second transformer at e speaker stepping the impedance down that of the voice coil.

While making this provision, it is usual provide several tappings on the 500-m secondary, such that the amplifier n be connected without serious mis-atch to one, two or several 500-ohm eakers connected in parallel.

Our present amplifier is an attempt satisfy one of these requirements, that the third category. It would be suit-le for all but the most elaborate sys-ns, yet still remain within reasonable nits of size and cost.

The result is a unit capable of de-ering 35 watts to the secondary of e output transformer, having provision r matching from one to 10 speakers a 500-ohm lines, and with facilities for xing one twin microphone channel and e pickup channel. As we said earlier, is will be adequate for the great major-of ordinary P.A. jobs.

OWER TAKE-OFF

However, we have not overlooked ose who may require more elaborate ut facilities. An output socket is unted on the side of the chassis, sim-r to the Playmaster system and this n power an auxiliary control unit, ntaining as many input and mixing ilities as we like to provide.

The output of this can go to the ex-ing pickup channel, allowing the pre-it pickup control to become a master ler. At the same time, the existing crophone channel is still available via present mixing circuit.

Reference to the circuit will show that e output stage uses a pair of EL34's (6CA7's) and these are operated in class AB at close to their maximum ratings. Under these conditions we had no difficulty in obtaining the expected 35 watts with negligible distortion of a sine wave input.

We spent some time arriving at a final design for the power supply, particularly as regards the final voltage it would deliver. With output valves of the type we are using, and when endeavouring to operate them as close to the maximum ratings as possible, more than usual care is necessary to ensure that dissipation ratings are not exceeded.

H.T. VOLTAGE

Such factors as the power transformer primary and secondary DC resistance, the output transformer primary DC resistance, plus the inevitable tolerances in other components—including the rectifier—all have a significant bearing on the voltage finally applied to the plate and screen.

Since it is impossible to control accurately all these factors, we have nominated a set of operating conditions which should keep everything wihtin ratings with most combinations. The power transformer is rated at 325V, 180 mA, and this should deliver just over 350 volts, measured at the output plates.

The screen dropping resistor is 1,000 ohms, which is higher than recommended by the valve manufacturers. However, it is a handy way to control the total cathode current, and may be varied, as required betwen 500 and 2,000 ohms.

A simple method of controlling the final voltage is to use a GZ32 or 5V4G rectifier. These will give from 10 to 20 volts less than the GZ34 and may therefore be preferred, if it is desired to use an existing transformer having a higher voltage rating. Alternatively a selected wire-wound resistor, wired between centre tap and chassis can reduce H.T. voltage to the required figure.

By avoiding the use of a filter choke we save considerable cost and weight, and the push-pull circuit eliminates any trace of hum due to ripple which may be present at the rectifier cathode. The earlier stages are supplied from a simple decoupling network, which is quite effective by reason of the small current drain required.

A 12AX7 twin triode is used as a cathode-coupled phase inverter and is thus able to contribute a useful amount of gain to the system. It is very similar to the circuit used in the No.12 Playmaster.

MIXER CIRCUIT

Ahead of this is an EF86 (or Z729) triode-connected, as a straight voltage amplifier. In the grid circuit is a simple mixer network, using two volume controls and two isolating resistors, one section connecting to the pickup input and the other to the output of the microphone pre-amplifier.

The pre-amp is another EF86, pentode-connected this time. The low noise and rigid construction of this valve shows to good advantage in this application, there being virtually no problem with noise or microphony and no need to resort to shock mounting of the socket.

The overall gain of the amplifier is quite high. The pickup channel will drive the system to full output with less

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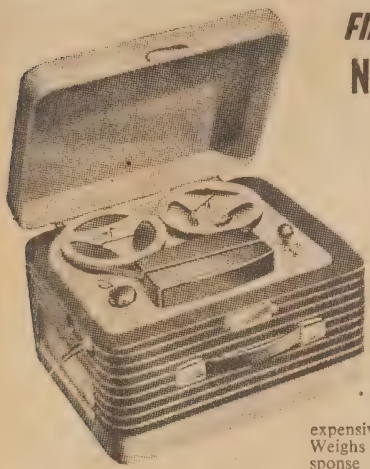

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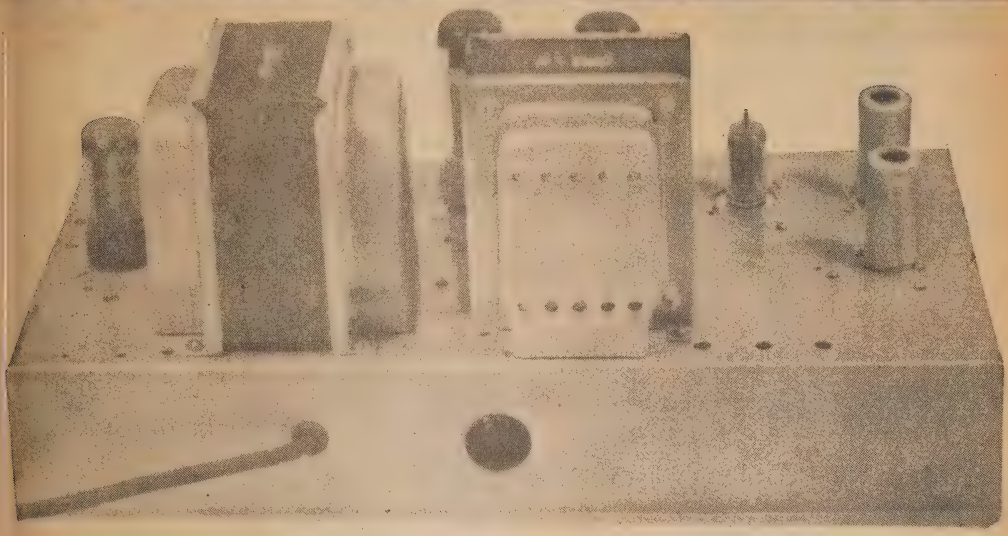

An excellent idea of the wiring and layout can be obtained from this underhassis picture. The GZ34 socket is on the extreme right, the two EL34's top entre, and the 12AX7 and EF86's on the left. Note the placement of the various terminal strips supporting the minor components.

han 200 millivolts input, while the nicrophone channel requires little more han a millivolt for full output.

As an example of what this means n practice, we were able to obtain satsfactory operation from a low impednce moving coil microphone without he benefit of any coupling transformer. While an unlikely condition in practice, t nevertheless gives a good idea of just vhat can be expected. When used with conventional crystal microphone the ain control does not need to be adanced more than a few degrees.

MIKE INPUTS

Two microphone input circuits are provided, being simply two parallel circuits. This arrangement has a number of limitations, but is so simple that we felt it was a worthwhile improvement over a single input. The limitations are hat the two microphones must be of similar type and have similar output, plus the fact that it is not possible to control each microphone individually.

However, provided these points are appreciated, the scheme can be quite a useful one.

Negative feedback is obtained from he 50-ohm tapping on the output transformer, and the constants are so selected as to give approximately 12 db gain reduction. This amount is adequate to provide most of the advantages expected rom a feedback loop, yet not so great as to introduce serious instability problems, particularly when we consider the probable variety of loads likely to be presented to any PA amplifier.

The decision to take the feedback from he low impedance tap was made after number of checks, and on the advice of the transformer manufacturer. The arrangement appears to offer two advantages; a reduction in phase rotation with consequent lessening of instability isks, and a more constant feedback characteristic with varying load conditions, since the feedback is aways taken from a loaded portion of the winding.

An important feature of the feedback loop is the 33pf capacitor shunting the 82K feedback resistor. This value was selected experimentally to give the best square wave performance (which is quite good, incidentally) consistent with maximum stability under varying load conditions.

However, if another make of output transformer is employed it may be necessary to alter this value. If a square wave generator is not available, the equipment should at least be checked with a sine wave and CRO, over the full range of power output, to ensure that it cannot be shocked into oscillation under any condition of operation. Ideally this test should be made into a speaker load, but a resistor may have to be substituted if there is no speaker system available to handle the full load.

FEEDBACK CIRCUITS

Another possibility we considered was the use of a feedback system which took the signal from one of the output plates, thus avoiding the output transformer and any associated variables. Unfortunately, from either plate singly, we get a very substantial hum signal, even though this is completely cancelled in the secondary circuit. Thus, we could only employ this system if we were prepared to use a large and expensive filter network.

All things considered, the present scheme appears to be the best one. The above problems are only mentioned as a precaution; being the kind of trouble likely to result from indiscriminate alterations to the circuit.

The output transformer is a new model by this particular manufacturer, and is intended to replace some of the older types. The primary is rated at 3,500 ohms plate to plate, and the secondary at 500 ohms, with suitable tappings. These are arranged to accommodate 2, 4, 6, 8, and 10 speakers, each having its own 500 ohm-to-voice coil transformer.

The provision of two speaker increments instead of single steps is a compromise, but a justifiable one. If an odd number of speakers should be required, the mismatch is still quite small, while the cost of the extra tappings would be appreciable.

TONE CONTROL

A simple top-cut tone control is provided and, although within the feedback loop, the constants chosen give an adequate degree of control. In most cases nothing more elaborate will be necessary.

The 6-pin outlet socket on the side of the chassis supplies heater voltage, a signal input circuit, a chassis connection, and two HT circuits. One of these is decoupled to suit the pre-amplifier stage, and is intended for use with whatever control units we develop. The other comes from the main HT line and is intended for use with a tuner, if this should ever be required. Note, however, that a tuner might easily draw 20 milliamps, requiring a transformer rating nearer to 200 milliamps.

The amplifier you see pictured is built on the same chassis as originally used for the 40-watt Factory Amplifier, described some years ago. This much is obvious from the fact that small valves occupy octal-sized holes, while the EL84 valves sit completely on top of the chassis, instead of being let part way through it, as was done with the 807's in the earlier unit.

What is more, space which was originally taken up by the filter choke is now vacant.

We would very much like to have made up a new chassis to correct these

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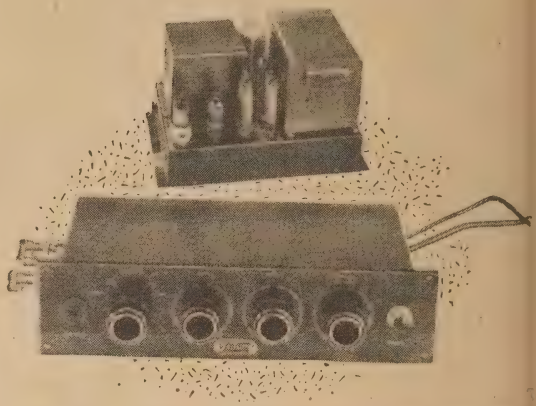

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nomalies but had to cut corners in the ysical sense to allow us more time to ncentrate on the electrical circuit.

Looking at the present chassis, it is vious that the rectifier valve could me forward into the vacant socket le alongside the EL34, allowing the assis to be shortened by at least two ches. The change would not involve y alteration whatever in the layout of e components in the amplifier section oper, so that our ideas and remarks in is connection stand good.

Readers, who are interested in the A. field may have their own ideas out amplifier size and layout, of urse, but we will re-examine the situa- on during the coming month and pos- bly issue a blueprint bringing the assis into line with present require- ents.

A good idea of the wiring can be ob- ined from the photographs, and we ust assume that anyone tackling a pro- ct of this kind will be able to work it the main points of the layout for mself. However, there are some im- rtant details worth noting and which ill help the reader to duplicate the iginal.

First the orientation of the valve sock- s. The EL34's have the keyway toward e power transformer, the 12AX7 to- ard the pickup volume control, and the vo EF86's toward the end, and slightly the rear, of the chassis.

ERMINAL STRIPS

Liberal use is made of terminal rips to support the minor components, iere being seven of the eight tag variety, id one four tag. The latter is used to rminate the primary leads of the ower transformer.

The others are used as follows: (1) o terminate the output transformer sec- ndary leads. (2) To support the 1,000 hm filter resistor, the 50 ohm centre ap resistor, and to terminate the 32 and 4 mfd electrolytics. (3) To support the L34 grid resistors, one of the .047 mfd oupling capacitors, and to terminate the rid stopper resistors and the other .047 fd coupling capacitor.

No.4 (near the 12AX7 socket) accom- odates most of the components assoc- ted with the phase inverter, including ie HT decoupling components, while lo.5 is almost an extension of No.4 nd carries the plate, screen, and de- oupling circuits for the mic. pre-amp- fier stage.

No.6 (parallel with No.5, on the other de of the socket) accommodates the rid and cathode circuits of the pre- mplifier stage, while No.7 (in the corner ear the other EF86 socket) carries the rid and cathode circuits, as well as the wo feedback components. Note that ese latter should be kept clear of the rid circuits.

Next point for consideration is the earthing" of the input circuits and the voidance of "earth loops" and assoc- ted hum problems.

The three input sockets (two mic., one ickup) are a standard type which is asily insulated from the chassis, the ecessary insulating washers being sup- lied with them. However, no spacing washers are provided and these may have o be improvised. Very short lengths of bout 8mm plastic tubing make ideal oacers.

A large solder lug is provided with ach socket, and these should be fitted nder the mounting nut, but insulated rom the chassis. This enables the earthy side of each socket to be earthed at a selected point near the appropriate EF86 socket.

All the input wiring is made with PT9M co-axial cable. This has the advantage of low capacitance per foot, as well as being insulated; an essential requirement where earth loops are to be avoided.

For the pickup input, the selected earth point is the earth tag on the terminal strip near the EF86 socket, and close to the grid pin (9). The two lugs either side are input points, one from the pickup, and the other from the pre-amp. The two .47M isolating resistors are mounted between these lugs and the grid pin of the socket.

They must be mounted in this position, with not more than a half-inch or so of lead attaching to the grid pin.

The shielding braid of the co-ax. is earthed at this point only. The earthy lug of the potentiometer is earthed to this braid, while the earthy side of the input socket bridges directly to this same lug. The co-ax. between the socket and the pot. is also earthed to the pot lug.

A similar procedure is followed for the mic. input circuits. The two sockets are connected together with co-ax. and the two earth lugs bridged together. The bridging co-ax. is earthed to one of the earth lugs, as is a longer length which runs to the grid of the first EF86. An earth point is established here, on an earthed terminal strip lug, as before.

The co-ax. connecting the mic. volume control to the mixer network of the second EF86 is earthed near this valve, as already mentioned. The other end of the braid serves to earth the earthy lug of the mic. volume control. Similarly, the co-ax. going out from this point (to the plate circuit of the first EF86) is also earthed here.

As well as the above precautions against earth loops, it is also desirable that the other earth points in the system be connected together by means of an "earth bus" of tinned copper wire. This is mainly to guard against poor contact with the steel chassis, either now or in the future.

The circuit shows a centre-tapped resistor across the heater line supplying the early stages. This will only be necessary if the power transformer has no built-in centre tap. In our case the transformer was a hurriedly built sample, but it is likely that the commercial version will be so equipped.

We tried connecting this centre tap to the cathode of the output valves to provide a "bias" on the heater line sa a precaution against hum. However, it provide a "bias" on the heater line as the simpler arrangement of earthing it direct to chassis.

In its final form the hum level was well below any practical level likely to be encountered in microphone circuits, and should not be a problem of any kind.

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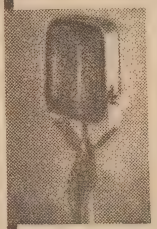

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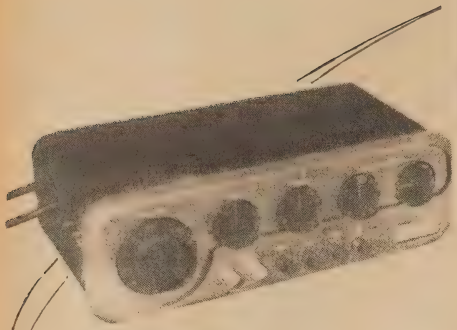

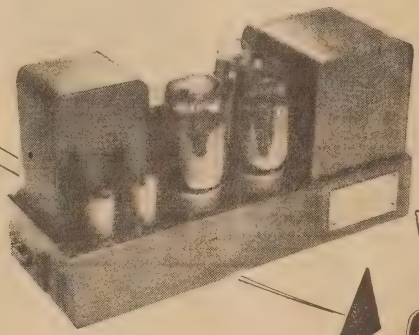

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PART 5—CHECKING LOUD SPEAKERS

ting felt partitions to remove standing waves, etc., but we soon decided that the benefits were outweighed by a loss of brilliance and "life" in the reproduction, so out came the trimmings. (Absorbents in smaller and/or rectangular enclosures are usually essential.)

The theoretical benefits of absorbent linings are clearly shown in the curves of Figs. 2A, 2B and 2C, which were taken in the open air with a microphone distance of 4 feet. The speaker is a 15-inch foam surround unit.

The dip at 200 cps is due to top-to-bottom standing wave effect inside the cabinet (distance 35½ inches—half a wavelength at 200 cps). In the reproduction of music the human ear does not notice a sharp dip on music as readily as it registers a peak. This dip is partially eliminated by the treatment of Fig. 2B, and more so by the extra padding of Fig. 2C, which also removes minor irregularities between 500 and 2,000 cps. The microphone is superior to the ear in noticing small variations in response.

MATTER OF CHOICE

As the 15-inch unit is normally used in the enclosure with a crossover at 1,000 cps or lower the dip at 1,200 cps can be taken as a blessing in disguise.

Now to the question of choice. I would wager the proverbial little apple that nine technicians out of 10 would plump unhesitatingly for the treated cabinet of Fig. 2C, but I still prefer the livelier performance of the untreated cabinet of Fig. 2A, and so do the majority of listeners.

A treated enclosure is always available for test and comparison purposes and we raise no objection if users like to apply the treatment at home.

All About Audio And Hi-Fi

In this article, the author gives some more information about his loud speaker listening tests and impedance measurements as an aid to evaluating performance. He also offers good advice to the home user who has no special equipment to assist him.

AT the end of Part 4 reference was made to the vent output from a 9 cubic foot corner reflex enclosure and the difficulty of including this in the main response curve. In order to see what comes out, one of these cabinets was turned upside down and the curve of Fig. 1A was the result. (Fortunately, sound waves do not know when they are upside down.) As it was impossible to prevent some of the sound waves from the front of the cone reaching the microphone, the vent was then sealed off and the curve of Fig. 1B was taken. The output from the port is therefore that of Fig. 1A minus Fig. 1B.

Mr Cooke informs me that the most difficult part of the test was turning the cabinet upside down. It is made with sand-filled panels and weighs some 272 pounds.

It is interesting to note that the dip in response around 200 cps which is shown in Fig. 2A is replaced by a peak in the vent output of Fig. 1A. This may account for the fact that the dip looks worse on paper than it sounds to the ear.

EAR VERSUS MIKE

Having stated that a listening test is more important than a response curve as the **final** arbiter of speaker performance, there must be instances where the two are in conflict, and where the pure technician would choose one system or modification but a keen listener would choose another. There can be little doubt that loudspeaker design is not purely a technical problem: it is an art as well as a science.

An almost perfect illustration of this point now follows. It is some seven or eight years since we built our first corner brick enclosure at a cost of about £2. (As we built it ourselves we did not have to pay union rates!) We naturally tried damping and padding the inside and fit-

It is worth noting that folded corner horns constitute a form of enclosure free from absorbent linings and many listeners like the reproduction in spite of irregularities from reflecting surfaces, which show up on a response curve but do not necessarily distress the ear.

Before leaving the subject of tests and response I should like to issue a word of warning about the use of variable frequency records for home tests of loudspeakers. Many test records with frequency bands going down to about 30 cps are being sold, but they can be rather dangerous and very misleading in use.

CAN MISLEAD

They are dangerous because they are used with power amplifiers. A speaker which will handle, say, 15 watts input on music might suffer very badly with 15 watts at a spot frequency in the 30-100 cycle region. Only theatre-type speakers could be expected to stand up to such punishment.

A reasonable domestic limit would be 3-5 watts, according to size of speaker and type of enclosure.

Most frequency records are misleading for many reasons. No self-respecting engineer would waste time trying to test speakers with such doubtful material; he would use a first-class BFO. Pickup and tone arm resonances are still prevalent and rule out any accurate assessment of speaker performance.

But, in any event, it should be stressed that frequency tests of loud-speakers always require experienced interpretation, because misleading buzzes and rattles often arise. A cotton bag over the speaker may vibrate and cause a rattle at one frequency, but not on music; a piece of mesh may do the same. A panel of wood or an object in the

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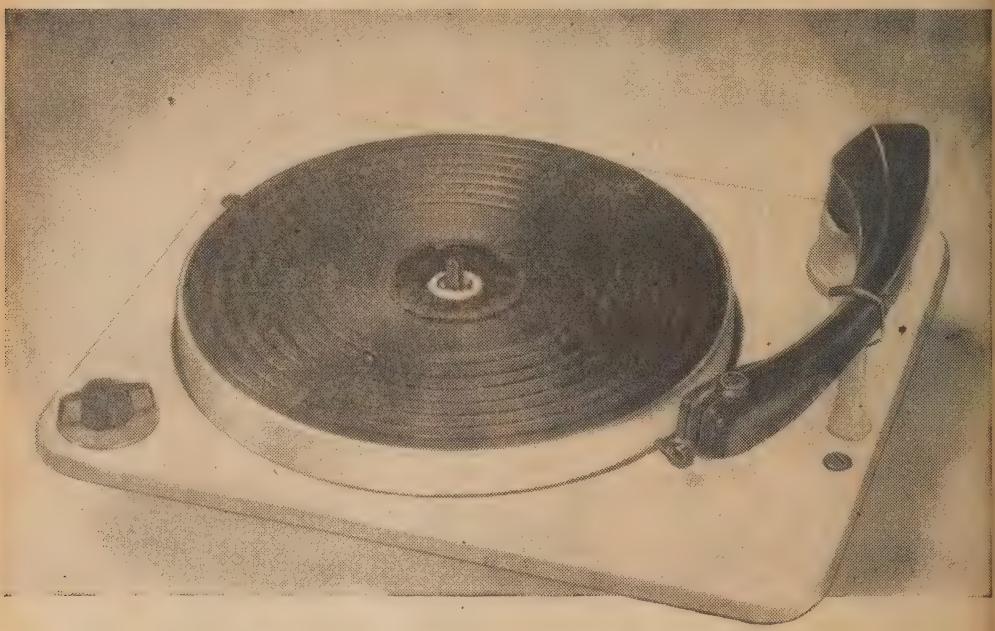

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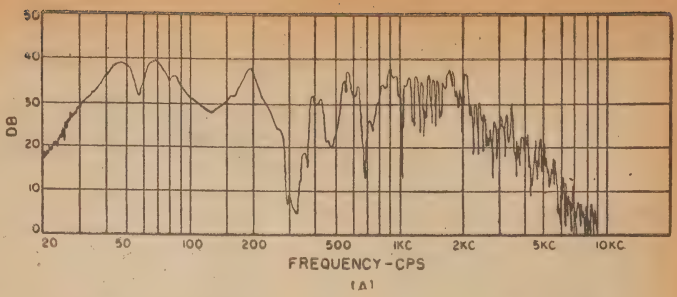
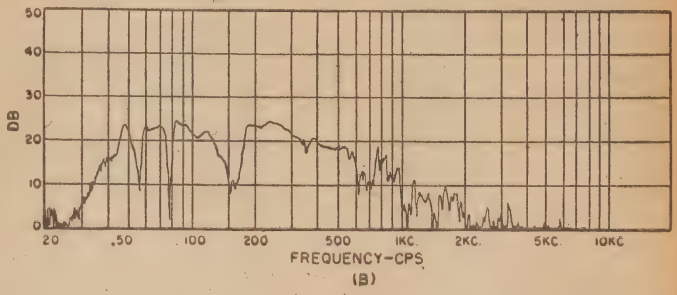
Fig. 1 — (A) Open air response curve with microphone close to vent of 9 cubic ft. corner reflex cabinet. Input 1 watt at 400 c.p.s. (B) Same setup as described for part (A) of figure except part close to show the stray radiation from front of cone.





room near the speaker may vibrate and sound exactly like a speaker fault.

The cone in a loud-speaker with the very desirable attribute of free suspension can move such a big distance with large input at its resonant frequency that it might actually hit the fabric or mesh placed over the speaker opening; many amateurs would mistake this for a fault.

A noise resembling severe frequency doubling at low frequency may occur with a speaker placed in one position in the room, but may disappear if the speaker is moved a couple of feet, especially with open baffle types known as "doublets."

As regards assessing actual frequency response at the extreme ends of the audio spectrum, the human ear is obviously most unreliable.

In writing the foregoing, I do not seek to deter users from making tests; I only wish to advise extreme caution, with a warning that 3 watts at 1000 cps may sound very loud, but below 100 cycles it begins to sound softer and softer, due to the ear, and it is foolish to try to make 40 cycles sound as loud as 1000 by stepping up to 20 watts or more.

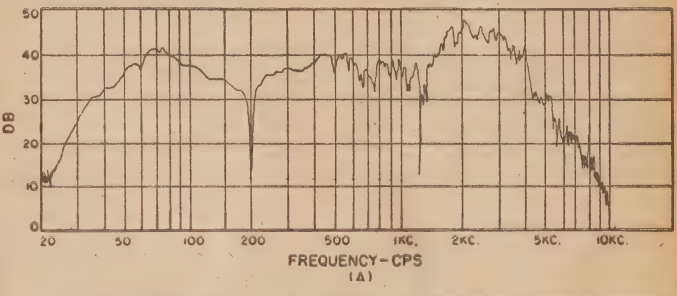
JUDGE ON OUTPUT

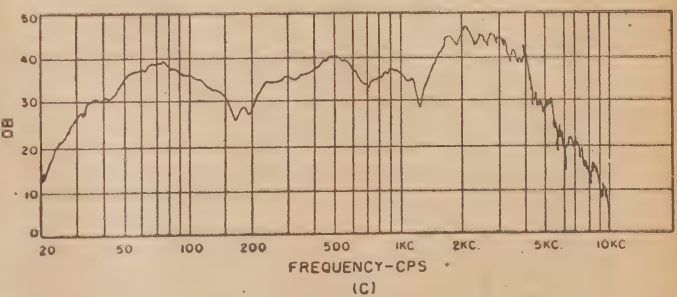
It is also most important to remember that it may be misleading to judge the performance of a speaker by its power handling capacity; it must be judged by what comes out — not by what goes in. After all, nobody praises a meal in a restaurant simply because it was expensive.

It is clear that acoustic enclosures—especially small ones — usually restrict cone movement and make it possible to pump 10 or 15 watts into a speaker which might knock badly at some low frequency at 5 watts on open baffle, where the cone is free to move as it listeth.

Any assumption that the enclosure is therefore two or three times as good as the open baffle would be a fallacy, because it is obvious that restricting cone movement reduces output and results in much waste of energy in small infinite baffles. Helmholtz resonators and exponential horns do, of course, help to push the low-frequency sound waves into the room where they are wanted, but even these devices are not always as efficient as is generally believed.

There is room for further investigation here and we are hoping to deal with





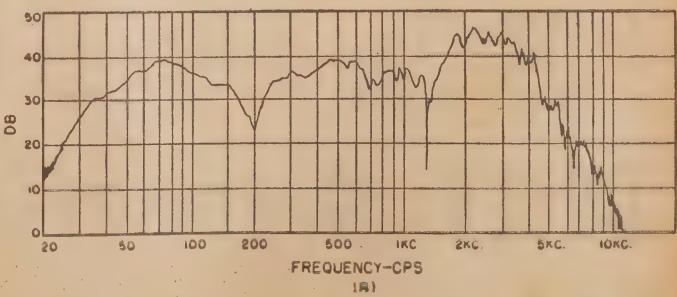


Fig. 2 — (A) Open air resonance of 9 cubic ft. corner enclosure made with sound filled panels. No absorbed lining was used here. The input was 2 watts at a frequency of 400 c.p.s. (B) Same conditions as for part (A) but with glass fibre scattered on the bottom of cabinet. (C) Same as for two previous tests but with sides, top, and bottom lined with 1 inch cellulose wadding and fitted with Wharfedale acoustic filter.

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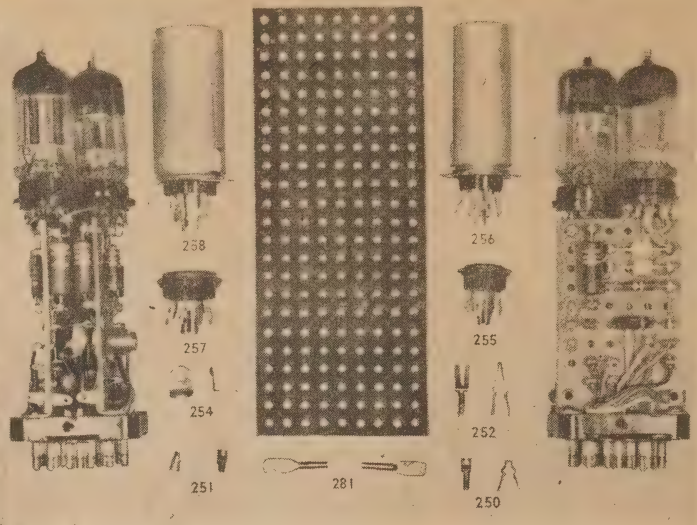

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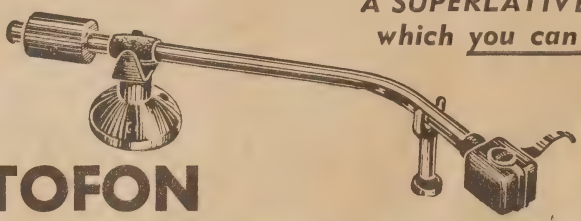

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the question in some future article in this series.

Directional effects are mainly responsible for the so-called efficiency of horn loading, and an open baffle is probably no less efficient in an average listening room (down to cut-off frequency due to size of baffle) because all the sound generated by the cone on both sides is used. The only way to increase such sound is by resonance and nobody wants to hear induced speaker resonances above 60 cycles.

To sum up on the question of home tests, my advice would be: (a) Always start frequency tests with the volume control in the minimum position and turn up cautiously, (b) judge low frequency performance by purity of sound rather than amount of noise, do not expect too much below 40 cycles (Happy is he that expecteth nothing.), (d) move about when listening, as position in room makes a big difference in what is heard at various frequencies, and (e) remember that pickup and tone-arm resonances still exist, and if one of these coincides with a speaker quite hefty effects may be produced.

IMPEDANCE CURVE

This brings us to the end of the section dealing with response tests.

For furnishing a quick and reliable picture of the status of different speaker systems, an impedance curve is almost sine qua non. Proud owners of multi-speaker systems with six woofers, six squawkers, and a battery of tweeters might well produce a level impedance curve as evidence of good performance.

The impedance curves of Fig. 3 show the difference between series and parallel connection of two speakers with different resonances. Parallel working always helps to smooth out irregularities and is preferable to series connection for the practical reason that one speaker continues to work if the other breaks down, and because series connection destroys much of the benefit of the high damping factor of the modern amplifier (there is virtually a resistance in series with each speaker).

BASIC FAULTS

Two basic faults of the moving coil speaker have always been the rise in impedance at fundamental cone resonance and at frequencies above 1,000 to 2,000 cps. The effects of the bass resonance have been largely counteracted by the high damping factor of the modern amplifier, and the steep rise in impedance with frequency has been reduced by the use of aluminium voice coils and other devices. The effect produced by an aluminium coil is clearly shown in Fig. 4.

The lighter weight of the aluminium coil improves performance at high frequencies, but this is also helped by better load matching to the amplifier. If the impedance of the speaker rises to double the output impedance of the amplifier at high frequencies, about half the available power is wasted in the mismatch.

One advantage in using two or more speakers with or without a dividing network is that a more uniform impedance/frequency characteristic is possible. This is clearly shown in Fig. 5, where the impedance of a three-speaker baffle system (referred to in the article on listening rooms) is shown to be virtually flat, apart from the bass resonance in the 20-50 cycle region, where it is taken care of by the damping factor of the modern amplifier.

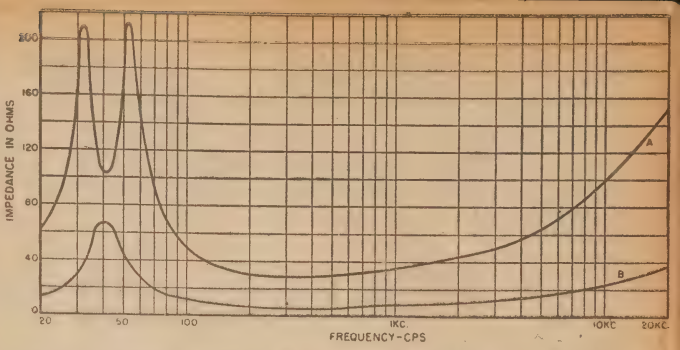


Fig. 3 — The above impedance curve shows the difference between series (A) and parallel (B) connection of the same two speakers having different cone references.

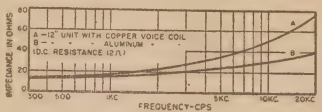


Fig. 4 — Impedance curve of a 12-inch speaker unit fitted with a copper voice coil (A) compared with a unit fitted with aluminium voice coil (B).

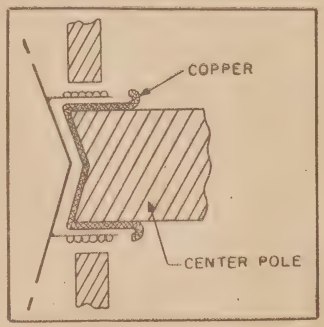


Fig. 5 — Copper damping cap adopted by Philips to reduce voice coil inductance and improve the performance obtainable at the higher frequencies.

By using three speakers with voice coils of different resistance it is possible to vary the current flowing through each speaker and so obtain a balanced overall performance. In the setup in question, the voice coils vary between 7 ohms and 17 ohms D.C. resistance, and are so arranged that the big unit does most of the work at low frequencies, but the tweeter takes precedence at the other end of the scale through a 4 ufd capacitor. The middle speaker is not allowed to make a nuisance of itself in any region—it merely helps to smooth the results. All this is done without the cost—in decibels and money—of a dividing network, which is usually essential with reflex and horn loading.

Apart from mass, it is the inductance of a voice coil which causes the rise in impedance as the frequency goes up. For a given resistance, the inductance of an aluminium coil is about 30 per cent less than copper. It was shown by Dr Olson that the inductance in the voice coil can be reduced by covering the centre pole of the magnet with copper. Philips has recently produced an interesting 8in speaker with a centre pole design as shown in Fig. 5.

REDUCING INDUCTANCE

With this arrangement there is some loss of flux density as it is obviously necessary to reduce the diameter of the centre pole to make room for the layer of copper. If this is .010in thick the magnet gap must be increased accordingly. On a 1in centre pole with a given magnet this would reduce a 13,000 gauss magnet to about 12,000 gauss.

Another method of avoiding undue rise in impedance is to use a powerful magnet and saturate the pole tip; this is costly, but it retains the benefits of high flux density, and has been adopted in one model by Goodmans.

Table 1 shows the rise in impedance between 400 and 15,000 cps with the various systems which have been discussed; broadly speaking, the improvement is in each case related to cost,

(Continued on Page 123)

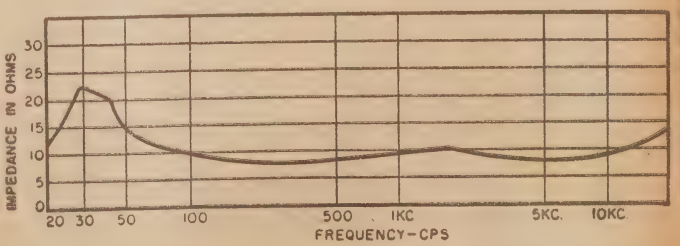


Fig. 6 — The impedance curve of the three-speaker baffle system described in the test.

Here's your answer, Tom!

It seems that Tom has been bitten by the audio bug. As a result he has been poring over loudspeaker and turntable advertisements in an effort to select some suitable equipment. Apparently the operating specifications and technical data available are confusing to the beginner, hence these queries.

In a recent loudspeaker advertisement I noted the statement: "The cross-over point may be placed at any frequency below 800 c.p.s." I would like to know what a cross-over point is and what is meant by the term c.p.s.

The term c.p.s. is an abbreviation for cycles per second. Electrically it relates to alternating current which, as its name implies, continually reverses its direction of flow. It rises to a maximum in one direction, drops to zero, then rises to a maximum in the opposite direction and again drops to zero.

A complete rise and fall in one direction and then in the other forms a cycle.

The rate at which this complete rise and fall occurs is termed the frequency and is expressed in cycles per second. As an example the frequency of your mains supply is 50 cycles per second.

In sound reproduction, frequencies ranging from about 20 cycles per second to about 15,000 cycles per second are involved. These frequencies are in the audible range, and when currents alternating at this rate are fed to a sound reproducing device such as a loudspeaker, they set up acoustical vibrations in the cone having the same rate of vibration.

The vibrations produced by a loudspeaker impinge on our ear drums and create a sensation of sound. These vibrations are not pure fundamental frequencies when speech and music are being reproduced but consist of fundamentals and harmonics. Combined, they have very complex waveforms.

When a single speaker is called upon to reproduce simultaneously a wide range of frequencies, some interaction between the frequencies being handled occurs and causes distortion.

SPEAKER SYSTEMS

Many ingenious schemes for overcoming this defect have been devised and these consist of twin cones, dual drives, curvilinear cones with metal diaphragms etc. These arrangements have resulted in a tremendous improvement on the standard speaker, although they are not a complete solution.

There are other disadvantages which follow the handling of full frequency range by a single cone.

One obvious way of overcoming such problems is to physically separate the cone areas reproducing different bands of frequencies; in other words, to break up the single speaker into two or three separate speakers, each progressively reproducing a limited portion of the range of frequencies.

In order to ensure that each speaker handles only its own range, a cross-over network, which separates the signal currents and feeds them to individual speakers, is introduced at the amplifier output.

A cross-over network consists of electrical filters, called low-pass and high-pass filters, which possess a characteristic of attenuating certain predetermined frequencies while they pass others freely. The point at which one section of the filter takes over from another is called the cross-over point.

Speaker manufacturers recommend various cross-over frequencies to suit their products. These may range from about 400 cycles to about 5,000 cycles depending on the speaker combination and the ranges they are designed to handle.

In practice the crossover frequency between the bass and treble units is not very critical and is generally placed somewhere below 1,000 cycles. In a three speaker system, however, a mid range speaker takes over from the bass unit and reproduces a portion of the range to about 5,000 cycles from which point a specially designed treble unit, called a "tweeter," handles the remainder of the range.

"I wish to complain about a TV programme you are showing next week."

"Flutter" and "Wow" are two more terms that have puzzled me. Would you explain what they mean?

"Flutter" and "Wow" are terms used to describe cyclic deviations from the mean running speed of turntables and other motor driven devices used in the recording and the reproduction of sound.

"Flutter" refers to the more rapid variations in speed, the term being so descriptive as to require little elaboration. The effect is frequently caused by inaccurate machining of moving parts in the cheaper turntables while wear of the rotating parts, through misuse, will be responsible for the same effect in better quality units.

"Wow," on the other hand, refers to slower variations in speed, again aptly descriptive. Light turntables, inaccurate machining and other factors combine to create this effect in the cheaper units. In better quality units this effect is kept down to negligible proportions and when encountered, indicates a mechanical fault.

Variations in speed create variations in pitch and, since the human ear is very sensitive to small changes in pitch, this fault is particularly devastating to fidelity reproduction.

* * *

I have often seen the letters AM and FM used in your publications. Would you tell me what these mean?

The letters AM and FM are abbreviations for the words Amplitude Modulation and Frequency Modulation respectively. These terms describe the two methods of broadcasting in use today.

In the amplitude system of broadcasting, a steady carrier wave is generated by the oscillator section of the transmitter. After amplification this carrier is fed into the aerial system and radiated as radio frequency energy.

This carrier would be of limited value to anyone tuning it in on a receiver as it would offer no information unless some intelligence were superimposed on it.

The process of superimposing this intelligence on the carrier wave is called modulation.

If the carrier wave were to be varied in strength in sympathy with musical tones or the human voice, then, through the process of demodulation in the receiver, it should be possible to reconstruct the musical notes and the speech.

The process of amplitude modulation

loes just that. Weak pulses from micro-
hone or pickup are amplified so that
hey are comparable with the RF sig-
al. The amplified audio is then applied
o the transmitter so that the RF signal
utput is made to vary in amplitude in
ympathy with the audio signal.

In the frequency modulation system,
owever, the carrier strength remains
teady while its frequency is made to
ary in sympathy with the amplitude of
he audio source.

The process of demodulation for this
ystem of reception is more complex
han for the amplitude modulation sys-
em, but there are notable advantages
n using frequency modulation.

★ ★ ★

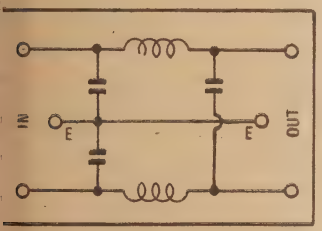
In a recent issue of your publication I saw mention of a line filter to eliminate interference. How is this accomplished?

Noise interference, Tom, comes from
wo main sources, natural atmospheric
tatic and man-made electrical appara-
us.

The first may be dismissed simply
ecause little may be done about it. The
econd form of interference, however, is
very different proposition, and precau-
onary steps can be taken in many cases.

Man-made interference is due to elec-
rical sparking and/or leakage in equip-
ient connected to power lines. It may
ange in effect from a crackling to a loud
uzzing noise.

Much of this interference reaches the
eceiver via the power lines. In some
ases, the cause of the interference may



Circuit diagram of a line filter.

e traced without too much difficulty,
nd the necessary steps taken to sup-
ress it. Unfortunately only a limited
umber of cases may be treated on this
asis.

The problem then resolves itself into
ne of minimising the noise which
eaches the receiver. The line filter does
ist that.

The circuit of a line filter is repro-
uced and a glance at this will reveal
iat little is involved. At the same time
is capable of dealing with quite severe
ases of interference. Simpler versions
f the filter are possible and, in some
ases, it may be sufficient to simply by-
ass the mains with two capacitors.

The function of the capacitors is to
rovide low-impedance paths to ground,
or interference signals, while the series
hokes present a high-impedance path.
hus most of the interference signal is
ypassed to ground.

How can a screen be kept at earth potential by bypassing it to earth with a capacitor?

A bypass capacitor does not hold screen at earth potential in the true sense of the term, since the screen is above earth by the applied DC potential. Rather it applies to the screen potential with relation to signal frequencies.

In an RF pentode the main function of the screen is to minimise capacitive coupling between plate and grid. The coupling tends to feed amplified signals in the plate circuit back to the grid and cause instability.

When a screen grid is inserted between these two electrodes, as in a tetrode or a pentode, the direct grid-plate capacitance is greatly reduced although capacitance still exists between plate-screen and screen-grid.

It is quite obvious that the screen would serve no useful purpose if the signals in the plate circuit were capacitatively coupled to the screen and thence to the grid.

The screen can only be a screen if it can be kept entirely neutral, in other words incapable of transferring signals from the plate to the grid.

The best way to prevent this happening would be to tie the screen to the cathode, but, unfortunately because of the relatively fine pitch grid in the position the screen has to occupy this would just about cut off the supply of electrons to the plate.

For this reason, the screen is operated at an intermediate positive voltage, which is sufficient to assist rather than impede the flow of electrons from cathode to plate.

The problem now is to provide a positive voltage on the screen and yet to tie it down so that it cannot transfer signal voltages from plate to grid. This is where the bypass capacitor comes into the picture.

SCREEN CAPACITOR

A capacitor may be charged to a certain DC potential, but it takes a certain time to increase or decrease the charge.

In the case of a screen bypass, it may be charged up to the screen potential, whatever this may be. The fact that a certain time is required for the capacitor to become fully charged is usually of no consequence.

In an IF or RF amplifier, we can prevent the plate from varying the AC screen potential simply by making the capacitor large in value. The conventional value of .1 mfd is too large to be charged or discharged at the signal frequency.

As a result the screen voltage remains at a prearranged DC figure and, since there are no variations in the screen potential, no signal can be transferred to the grid.

In audio amplifiers, although the screen is more concerned with other functions than the plate grid capacitance, the same requirements have also to be met, namely that the screen should not be able to change its AC potential in sympathy with the signal.

The storage effect of screen bypass in an audio amplifier has to be greater on account of the lower frequencies involved, and values of up to 8 mfd are used for certain applications.

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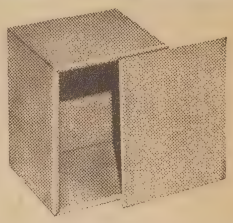

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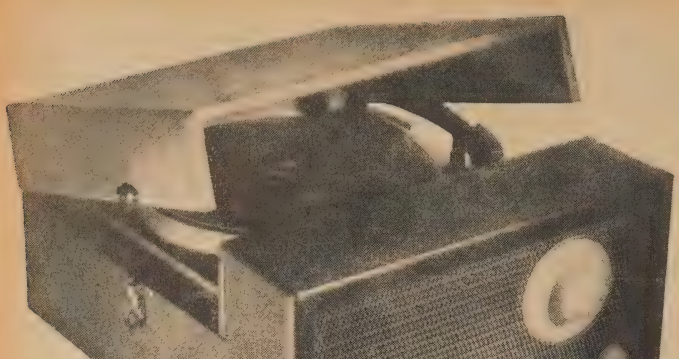


The Portagram makes a handsome showing in its two-tone case, fitted with lid clips, and a carrying handle on the far side. Expanded aluminium is backed with red fabric.

Our New Portagram Radio And Records

A handy, portable radiogram for utility use, complete with instructions for building the carrying case. Ideal for parties, small rooms, or a second set which will play your favourite records when not being used for radio reception. Covered in two-tone leatherette or plastic and trimmed with expanded aluminium grille and cream plastic controls it is both smart in appearance and sturdy in use.

by
Wes Yashin

THE popularity of radiograms and record players seems everlasting. Counter attractions come and go, but the sale of records mounts higher with each month. Many thought that TV would deal a big blow, but this is far from the truth.

It seems there is no substitute for playing the music you want when you want it. That's the secret of record-player success. Whether you feel like hearing a symphony, oratorio or just plain mood music, it's always there night and day.

NOT ALL LARGE

Nor are radiograms confined to large, expensive things in shiny cabinets and with lots of power. Naturally these may be expected to sound best of all, and are virtually an essential for the man who is looking for the very best in audio quality.

But not everybody can afford a big job, and for that matter not everybody has the room to house one if he had it.

There is obviously a big field of interest in something small and portable, with a modest output and frequency response, but which makes up for its inevitable limitations by being easy to use, to store, and to carry about.

In a sense, such a machine takes the place of the old-fashioned portable gramophone, which was a never-very-satisfactory medium with much the same aim in life.

The electric model however has wiped most of the disadvantages of the old portable, demanding only that there is a power point within range of a connecting lead.

There is no spring motor to be wound volume control is quite easy, quality is immeasurably better, and size is about the same.

Moreover it's quite easy to include a radio tuner, so that the device is a very satisfactory table receiver with a comparable order of performance as an ordinary mantel set, and in most cases a good deal better.

PORTABLE EQUIPMENT

The case for the portable equipment is well illustrated by the number of most attractive models which have made their appearance lately in both radiogram and record-player form. They are simply small radio receivers or simple amplifiers built into carrying cases which also house a standard 3-speed gramophone motor.

But for impromptu dances, for parties, and for use in small rooms and flat buildings they are just the thing.

We could see no reason why we shouldn't be able to make up a job on these lines, our only difficulty being that we have no pretty plastic case to put it in.

But if you look at the picture at the top of this article, we think you'll agree that we needn't worry too much about appearances when we can make up such an attractive cabinet with ordinary home carpenter's tools.

The design is self-explanatory — we finished it in plastic cloth, light blue-grey for the lid and a darker blue for the main body. The front panel is set back a little to protect the knobs, and is faced with a sheet of expanded aluminium behind which is a layer of dark red cloth which also covers the speaker cut-out.

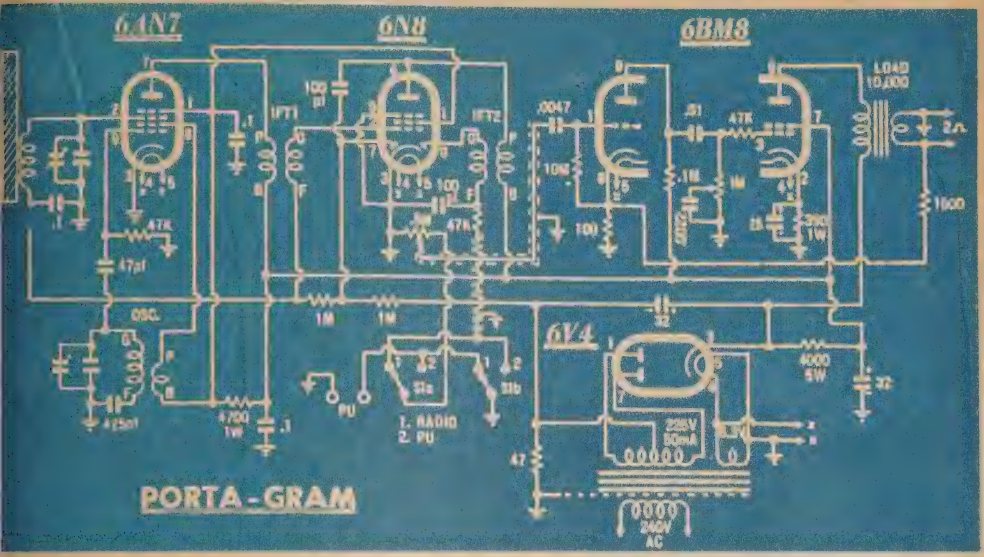
The finished cabinet is as attractive as one could desire, and it certainly won't crack if you have an accident with it. The plastic cover will stand plenty of wear, and is easy to clean.

It sounds good, too, surprisingly good. If you take trouble to make everything physically firm it will take ample volume without distress, and the oval speaker gives a very good approximation of bass response, despite the limited baffling area. It is probable that the stout wooden case has a good deal to do with this.

GENERAL DESIGN

After a few evenings' constant use on both records and radio, the Portagram has become a firm favourite with the entire family.

THE CIRCUIT OF OUR NEW PORTA GRAM IS SIMPLE



The circuit is straightforward, similar to that used for other small re ceivers. Its output is about 1.9 watts.

his is the way its design developed order to keep the size within limits. measured up all the popular record yers now available, and set the base- rd dimensions, height, etc., large ugh to accommodate them all.

Ve did not bother with record ngers, for these are bulky, and the jority probably wouldn't require m. A changer could be used by reasing the height of the cabinet ensions at some sacrifice in appear- e.

We then worked out the dimensions the front section which carries the aker and the controls. The oval aker was a great help here, reducing r-all height and allowing the magnet clear the motor board. The chassis out was fairly simple, as there was quate room after settling on these nensions to accommodate a fairly ndard layout.

IE CIRCUIT

For a circuit, we adopted a simple ar- gement similar to that used previously small receivers. It features the M8 output valve which gives as much ume as the general design can stand h enough gain to work well from an linary crystal pickup. As precise play- k curves are not practicable or even essary in such a unit, a fairly solid cut tone control levels the output en playing records, and is also useful radio.

The receiver used a loopstick aerial to ke the equipment entirely self-con- ned. These aerials, while not equal an outside wire, give plenty of pick- for local stations, and even a few ng distant programs.

Technically, there is not likely to be ch difference between our version and ny of the commercial equivalents, and performance should be much the same.

The circuit has been described in detail on other occasions, and we need do little more than run through the main points.

A 6AN7 converter valve is used in the first stage, its loopstick being mounted inside the cabinet—any standard stick will do—and the oscillator coil on the chassis. A single IF stage follows, the diodes of the 6N8 being used for detection and AVC. It connects to the audio stage through a switch which changes from radio to pick-up. The volume control, also inserted at this point, is common to both channels.

An ordinary speaker output transformer is employed, as there is no point in using hi-fi components. Negative feedback from the voice coil is about 10 db.

Feedback is probably as important in damping speaker resonance as in reducing distortion, for our requirements are not in the hi-fi class. It also reduces sensitivity, so that some experiment is permissible with these points in mind if you feel so inclined. But you will probably find our suggested values a good compromise.

No filter choke is required, and the power supply is quite modest.

The output of the output stage is

PARTS LIST

1 Chassis 7in x 7½in x 1½in.
1 225/225 50 mA power transformer.
1 Circular perspex dial (Jabel).
1 2-gang miniature (Roblan), with long shaft.
1 Loopstick aerial.
1 Miniature oscillator coil.
2 455 Kc miniature IF's.
4 Noval sockets.
1 Miniature 4-pin plug and socket.
2 Trimmers.
1 5 x 7 Oval speaker & 10,000 transformer.
1 2 x 2 Oak switch.

VALVES
1 6AN7, 1 6N8, 1 6BM8, 1 6V4.

CAPACITORS
3 .1 mfd 200 volt paper.
1 .047 mfd 200 volt paper.
2 .01 mfd 200 volt paper.
1 .0047 mfd 200 volt paper.
1 425 pf padder.
2 100 pf mica or ceramic.
1 47 pf mica or ceramic.
1 25 mfd 40 volt electrolytic.
2 32 mfd 350 volt electrolytics.

RESISTORS
1 meg potentiometer.
1 .5 meg potentiometer with switch.
1 10 meg ½ watt.
2 1 meg ½ watt.
1 .1 meg ½ watt.
3 .047 meg ½ watt.
1 1,500 ohm ½ watt.
1 100 ohm ½ watt.
1 47 ohm ½ watt.
1 4700 ohm 1 watt.
1 390 ohm 1 watt.
1 4,000 ohm 5 watt.

SUNDRIES
3 knobs, 2 terminals, nuts and bolts, solder lugs, hookup wire, tinned copper wire, spaghetti, shielded hook-up wire or coaxial cable, length of power flex and 3 pin plug, scrap metal for gang-mounting brackets, 1 7-lug strip, 1 5-lug strip, 2 4-lug strips, 1 3-lug strip, 1 2-lug strip.

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THO1 E.H.T. Transformer.	£3/7/1
THO2 (90 deg.) E.H.T. Transformer	£3/9/9
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13 x 7 x 2½	21/9
11 x 8 x 2½	17/6
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17 x 10 x 3	30/-
17 x 12 x 3	32/7

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C5/1 20H/100mA	44/-
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C1/1 20H 150mA	92/10
C6/1 20H/200mA	126/-

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Ceramic HI-K1 Disc. (Subminiature) 2.2 pf. — 400 pf.	2/1
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50 x 50/350V	21/6
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100 MFD./350V	19/9
U.C.C. Special "Dectrofash" MFD. 250V W	650 46/7
Ducon Paper Capacitors	
.001—.006 600 Volt	1/2
.01/600	1/3
.02/600	1/5
.03/600	1/6
.05/200	1/2
.05/400	1/4
.05/600	1/7
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.1/400	1/9
.1/600	2/-
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.25/400	2/5
.25/600	2/11
.5/200	2/7
.5/400	3/11
.5/600	4/1

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5-7H	£2 8 0
5-7L	£3 3 6
6H	£2 5 0
6M	£2 18 6
6-9H	£2 15 0
6-9L	£3 9 6
8H	£2 10 0
8K	£2 12 6
8M	£3 3 0
8-PA	£3 3 0
12K	£3 6 0
12M	£4 1 0
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12-0 Deluxe	£6 10 0
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2 x 5 x 3	24/10
3 x 3 x 1	11/7
3 x 3 x 2	17/10
3 x 3 x 3	24/10
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1.7 watts, and this should be

e again we have omitted a back tuning dial and used in its place is virtually a large plastic knob hich is attached a scale carrying n call-signs. This tuning knob was ally produced for one of our baby nd is ideal for this purpose. You of course, make up any kind of scale you desire, but we like the hown. Tuning is therefore direct, no vernier drive. You will have ouble on this score.

a good plan to thread felt washers shafts before mounting the knobs, oid scraping on the metal.

order to group the controls on ront panel, the tuning gang is ted on metal brackets rather high air. This lengthens the leads to scillator coil, but there is no great vantage in this. Incidentally, circuit ers are mounted to the gang, which r case was a Roblan. Other small might be used with slightly dif- mounting.

ITROL MOUNTS

other three controls—volume, p switch and tone—are mounted lip bent up from the chassis metal it we can keep the chassis depth as as possible. This is to allow com- ts to fit under the motor-board ut fouling. Otherwise the chassis ventional.

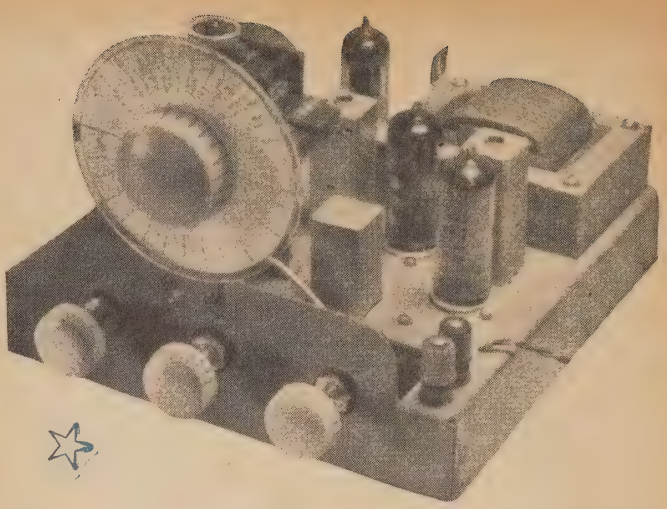
e are some hints to help you when bling the cabinet.

used 3-8in plywood for the con- ion of the cabinet, this being suffi- y rigid while keeping the overall t down. The joints are simple butt made with the assistance of panel and glue. The essential details are in the accompanying diagram and ifficulty should be experienced in onstruction.

you are a competent carpenter, there is no reason why more elaborate joints should not be made.

Commence by laying out and marking the various pieces to be cut out in order to minimise waste. Allow some overlap for the planing and sanding operations which may be performed, two or three pieces at a time held in the vyce, prior to assembly.

The L-shaped sides of the cabinet are cut from a single piece and are overlapped by the rear, top and bottom pieces. This assembly is completed first and is followed by the front piece which overlaps the whole.



In this view are seen the oscillator coil (centre) converter valve, IF transformers and valve and rectifier at the left of the power transformer. Terminals are for pickup. Twisted lead goes to the loopstick aerial.

The front piece is best attached as a whole panel and the cut-out made after the glue has set to prevent fracturing the ¼in wide border which remains.

The dimensions given are critical in that they are the smallest permissable to give sufficient clearance for the components on the chassis. However, an increase in the dimensions to allow for a record changer or larger components would be in order.

No allowance has been made in the given dimensions for the thickness of the covering material since this may vary. Individual constructors should alter the dimensions to suit the covering material to be used. The sections affected are the lid, the top piece, the motorboard, and the rear insert piece. Clearance between surfaces must be allowed equal to twice the thickness of the covering material, otherwise the lid, for instance, will not close, or it will jam when shut.

The lid assembly is quite simple and requires little comment. The motorboard is an almost square panel with a cutout to suit the player unit to be used. A template for the cutout is generally included with the player unit.

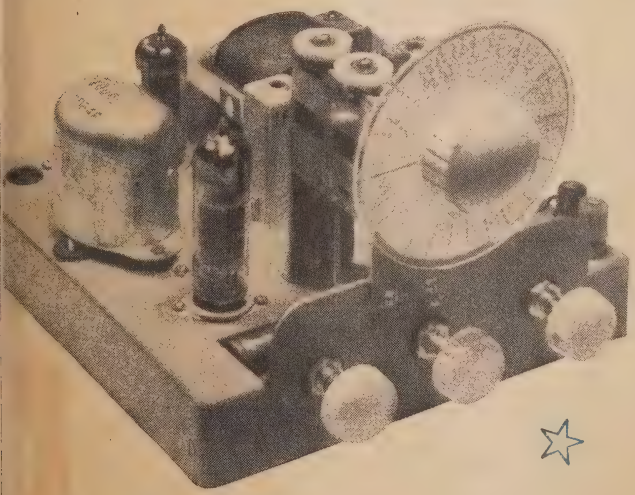
MOTOR BOARD

After the assembly of the cabinet is completed, cleats of ½in plywood, to support the motorboard, may be attached to the sides and rear of the cabinet.

The baffle will require an oval speaker cutout and ¼in holes for the gang, potentiometer and switch spindles. Do not make these holes larger as the chassis is partly retained by a close fit of the spindles in these holes.

Wait until you have completed the chassis before making these holes so that you can mark their exact positions using the spindles themselves a a guide.

Since square edges do not enhance the appearance of the cabinet, we suggest that you round off the edges and the corners. The degree of curvature will be limited by the thickness of the plywood,



method of gang mounting is illustrated here. At the left are the output valve d output transformer. Speaker socket is at the rear. Controls L to R are Tone control, Pickup switch, and Volume control.

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102	First video. 6VX6	14/-
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105	Fourth video. 6BX6	14/-
106	Fifth video. 6BX6	10/-
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110	First C.T. Sound	10/6
108	Second Sound bifilar	11/6
111	Second Sound. pri. and sec.	11/6
109	Third Sound ratio detector	18/-

Coil Former ¾" square can with two cores

Part No.		
506	4-pin coil assembly	4/3
507	4-lug coil assembly inc. 2—47pf.	7/4
508	5-lug ratio assembly, inc. 1—22pf and 1—47pf.	7/4

Video and RF chokes filament and filter chokes

Part No.		
408	Aer. RF choke. C.T. 2ub.	3/4
409	2uh filament choke	3/4
410	15uh video choke	3/4
411	47uh video choke	3/4
412	150uh video choke	3/4
413	330uh video choke	3/4
414	TV noise filter. 2 amp	3/4
415	3uh damper diode choke	3/4
416	43uh TV noise filter, ½ amp	3/4
417	82uh ratio choke, 1½amp	IC 3/4
418	10uh video r.f. choke	3/4
419	22uh video r.f. choke	3/4
420	27uh video r.f. choke	3/4
421	33uh video r.f. choke	3/4
422	39uh video r.f. choke	3/4
423	56uh video r.f. choke	3/4
424	68uh " " "	3/4
425	82uh " " "	3/4
426	100uh " " "	3/4
427	220uh " " "	3/4
428	270uh " " "	3/4
429	390uh " " "	3/4
430	470uh " " "	3/4
431	560uh " " "	3/4
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61	4v 1 amp. 5kv ins.	26/
62	6.3v .6 amp. 5 kv ins.	26/
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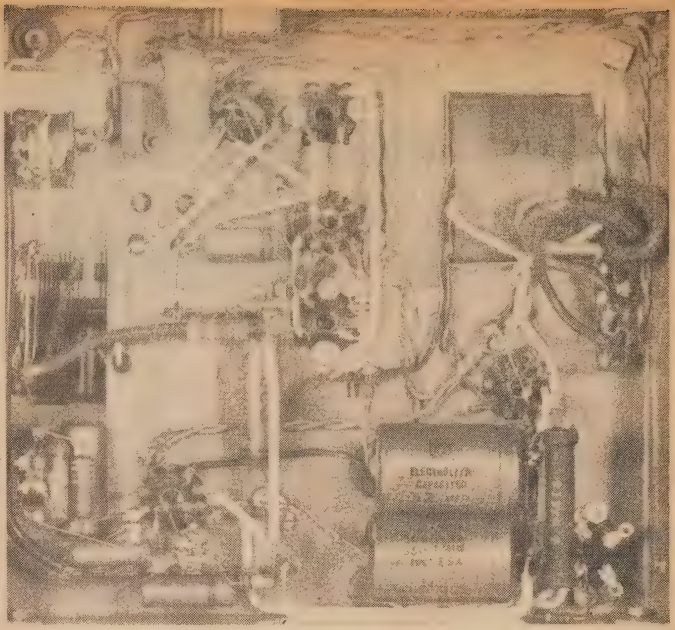
a reasonable curve may be obtained
ut weakening unduly the joints.
re edges do not wear well, and the
ing material is too easily damaged
e.
rough file or rasp, followed by sand
will produce a neat appearance
with power sanding facilities will
he job considerably simplified.
vering of the cabinet should not
difficult. If your choice is leather-
then select the thinnest possible ma-
which is the easiest to work. Or-
y cold water glue is quite suitable
should be mixed to a consistency
gives maximum adhesion while

obtain a perfect joint with two
s of leatherette, overlap one end
the other, then, with the aid of a
ht edge, cut midway btween the
nds with a razor blade. Remove
oose ends and a perfect butt joint
d result.
little thought will enable you to
these unavoidable joints where
are least noticeable.
ien glueing on the leatherette, rub
ie air bubbles trapped with the glue
io not stretch the material which
iave been softened by the glue. If

RCUIT VOLTAGE AND URRENT READINGS

asurements were made with a
ndard multimeter having a sen-
vity of 1000 o/p/v on no signal
nditions. Output stage voltage
asurements are to cathode
al HT current drain, 47 ma.
gh Tension after the filter, 230 volts.
thode current of the output valve.
26 ma.
s on the output valve, 9.8 volts
te current of output valve, 22.5 ma.
te voltage of output valve. 230
volts
een current of output valve,
3.5 ma.
een voltage of output valve 125
volts.
and IF plate voltage, 135 volts.
and IF screen voltage. 85 volts.
F and IF bias, 2 volts.

hed, the material will shrink or
g and a gap will form at the joint.
e rear insert piece will require an
ing directly behind the speaker to
e the back pressure and to reduce
ess. A completely uncovered open-
would not look so good. We over
this by completely covering the
t piece, and placing a razor cut in
eatherette, lengthwise, and centrally
th opening.
better scheme would be to reduce
rear insert to a virtual framework,
then to mount a strip of expanded
minium behind it.
ie extra opening this method pro-
also allows better air circulation
h helps to keep the chassis cool.
ie baffle should be covered by some
ired material which can be seen
gh the expanded aluminium and en-
e the appearance. The expanded
minium is held in place by the baffle
h is retained by wood screws in each
e four corners.
ur cabinet was finished in a two-tone
ngement, the lid being grey and the
blue. The expanded aluminium has
ld anodised finish while the backing



The Converter valve socket is seen at the top of this picture with the IF stage in line towards the centre. Rectifier valve at right centre and output valve at lower left. Filter capacitors and resistor at lower right

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FEATURING:—

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(20 cps to 20,000 cps. at 7.5 ins. per sec.)
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material was burgundy. However, vidual constructors will undoub select colour schemes to suit per tastes.

As a final step, fit the hinges, lid a carrying handle and some rubber

THE CHASSIS

The chassis may be made from 1 18 gauge aluminium or steel for w blueprints will be made available ir usual manner. Under-chassis and view photographs are reproduced, you should have no trouble with placement of components. Under chassis there is ample room even fo largest sizes and, at no time, sh crowding be experienced.

Looking over the rear edge of chassis with the controls at the top converter valve socket is the first in near the right edge of the chassis. gap in the pins on this socket look ward the lower left corner of the ch

The oscillator coil is a little above to the left of the converter socket. first IF transformer is directly below converter socket. The P and B pin this transformer face the right edg the chassis.

The IF amplifier socket is to the of the first IF transformer and the in the pins of this socket faces the u right corner of the chassis. Next in and to the left of the IF ampl socket, is the second IF transfor and its P and B pins face the rear of the chassis.

AUDIO VALVE

In the upper left hand corner we the audio valve socket with the ga its pins facing the left edge of chassis. The rectifier valve is loc almost midway between the power tr former and the left edge of the cha The speaker socket may be seen in lower left corner.

The wiring is quite straightforw many components being suspended p to point by their pigtails. Those re ing a longer run are anchored with aid of tag strips.

A seven-lug strip near the audio v socket supports the plate load res of the triode section, the coupling acitor to the grid of the output sec one end of the grid leak in the ou section, and one end of the coup capacitor between the triode section the volume control.

Above the second IF transform four-lug strip supports the IF and screen dropping resistor as well as end of the diode load resistor.

THE IF CHANNEL

To the right of the converter v socket a three-lug strip supports AVC bypass and the leads to the l stick aerial coil.

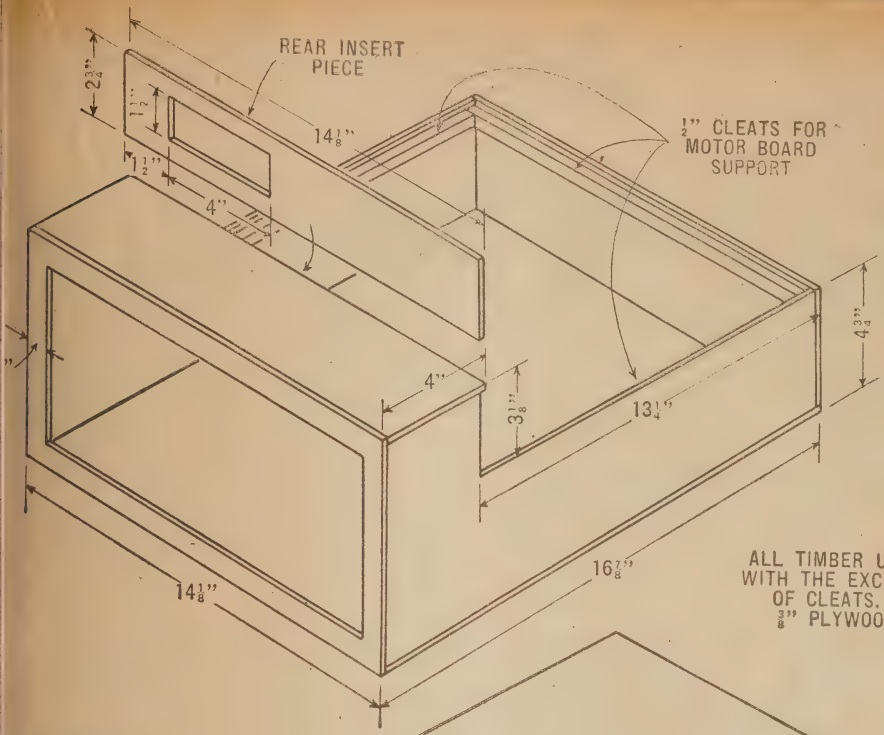
The back-bias resistor as well as earthy ends of the first electrolytic the AVC return resistor are suppo by a two-lug strip to the left of second IF transformer.

A five-lug strip between the rec and speaker sockets supports the components and one end of the feed resistor. The incoming AC leads as as the power transformer leads and t returning from the switch are termin on a four-lug strip situated midway a the rear edge of the chassis.

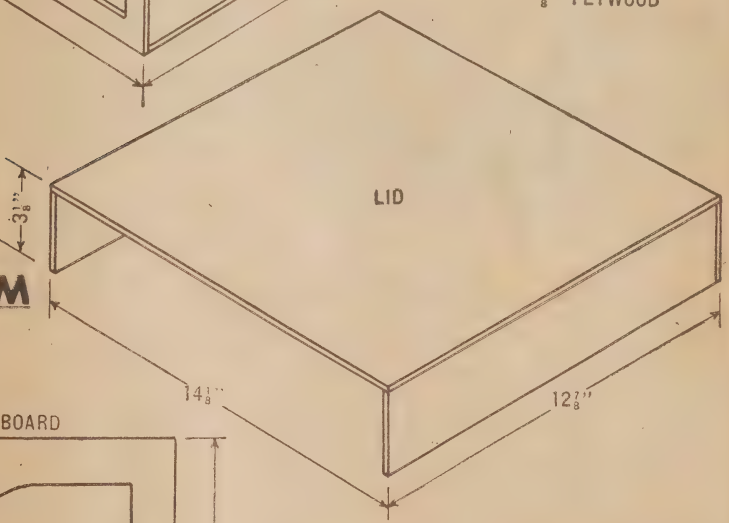
The loopstick may be placed hori tally along the top of the baffle to the right corner of the cabinet. A

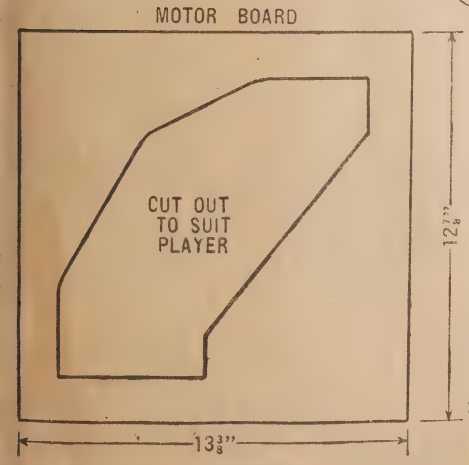
(Continued on Page 127)

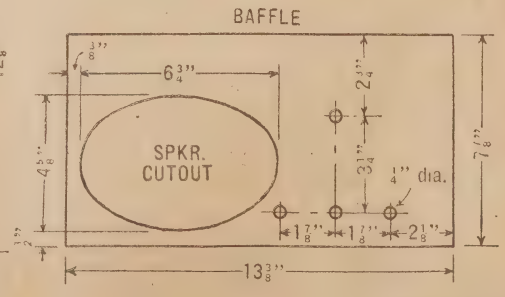
CABINET DETAILS FOR ORTA-GRAM

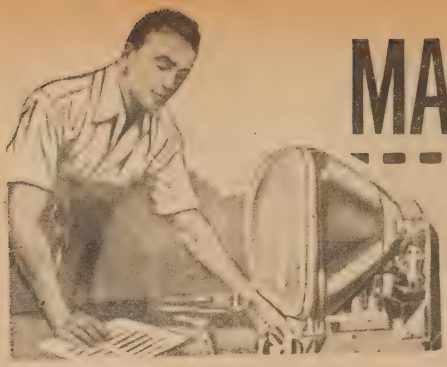


ALL TIMBER USED, WITH THE EXCEPTION OF CLEATS, IS ⅜" PLYWOOD









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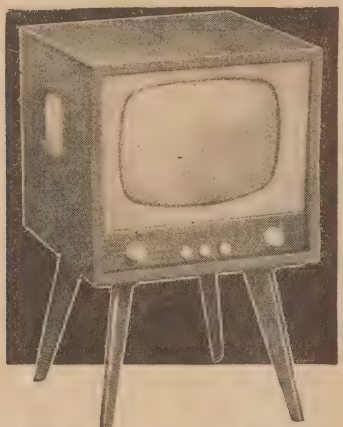

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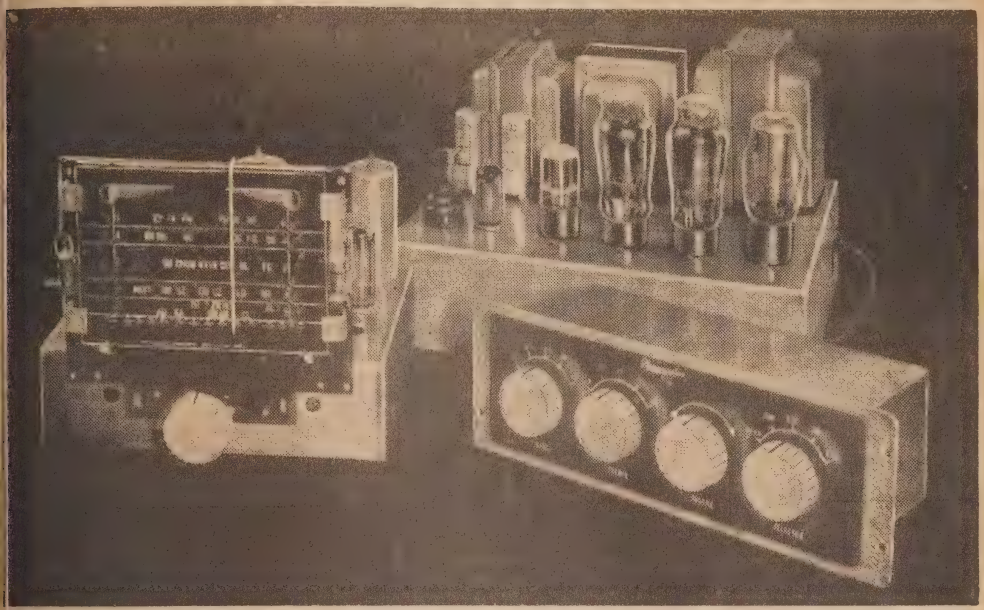

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HOW TO GET YOUR AMATEUR LICENCE

Tens of thousands of amateur transmitters all over the world will testify that theirs is the grandest of hobbies. It opens up a new world of interest and instruction, and the fascination of talking to others in far-away countries. It is the best possible training ground for prospective engineers. With some application and aptitude you can also join the amateur ranks.

THERE has been much publicity of late about the importance of science. Many people, whose everyday work is completely unrelated to scientific things, feel that they would like to expand their scientific knowledge.

What better and more profitable way of doing this is there than amateur radio? A short period of study to pass the proficiency examination gives you the basic knowledge, after which you can undertake an endless variety of experiments with radio receivers, transmitters and aerial systems.

As soon as you get "on the air," you will find there are thousands of enthusiastic amateurs, young and old, male and female, to whom the fact that you are an amateur is an open door to friendship.

FINE TRAINING

Apart from being a fine hobby, there is always the possibility that amateur radio will lead to a lifetime career in electronics.

Operators with amateur experience are several steps ahead when it comes to the operation of commercial stations because they have developed a "feel" for radio equipment.

Haywire hookups aren't tolerated in commercial practice, of course, but the experience of having handled components and noted their effects in circuits is denied many commercial radiomen. Many of these have gone through the radio colleges without at the same time experiencing their share of personal experiment and practical use.

Many of today's research scientists and engineers, men with full professional standing, can trace their careers back to an early interest in amateur radio.

Some of these men, while radio amateurs, made major contributions to the art, and there is no doubt that they, and a coming generation of amateurs, are continuing to make such contributions.

NO NEED TO SELL!

It won't be necessary to sell the majority of "Radio, Television and Hobbies" readers on the idea of joining the radio amateur ranks.

A number of them already hold licences and many others have been indoctrinated by visiting stations owned by friends. Because of this wide amateur interest, we try to include a due amount of material of interest to amateurs—descriptions of receivers, transmitters, test equipment, &c.—in the magazine.

But this article is intended to help those who would like to become amateurs but who don't quite know how to go about it.

Most would-be amateurs know that they are required to sit for an examination before obtaining a transmitting licence, but not all of them know just what is required academically or how best to prepare themselves for their tests.

Let us therefore consider some background on the subject before talking about the examination itself.

FREQUENCY ALLOCATIONS

Radio communication is now essential to the navigation of thousands of ships and aircraft, not to mention international message handling and communication circuits.

Co-ordination between nations on the use of the radio spectrum is therefore necessary so that there will be little mutual interference. Ships and aircraft moving between countries should also be able to communicate with control stations, weather stations, etc., with as little trouble as possible.

The way in which the frequency spectrum is split up is decided at an international telecommunication convention at which are represented the governments of all the major countries in the world. The last such convention was held in Atlantic City, U.S.A., in 1947 and another is to be held in Geneva in 1959.

The authority which carries out the decisions of these conferences in Australia is the Postmaster-General's Department through its various radio branches. The department carries out in detail the local rules and administration of all radio stations in this country.

THE A.O.C.P. REQUIREMENTS

Matters such as the frequency or range of frequencies in which individual stations may operate, the allowable power level and, more to the point of this article, the minimum knowledge and skill required of the operator in order that he can operate his station efficiently and without interference to others, are decided by this authority, which acts within the framework of international agreement.

The required minimum standard is established by the Amateur Operator's Certificate of Proficiency (A.O.C.P.) which is issued after the applicant has passed the appropriate examination.

Having obtained the certificate, it is largely a matter of routine for the individual to obtain a station licence and be allotted a call sign. The latter will be prefixed "VK" to indicate an Australian station, a following number to nidicate the State and a final combination of two or three letters for individual identification. If you live in New South Wales you could be VK2AZZ or if in Queensland VK4XYZ.

The qualifications required to obtain the A.O.C.P. Certificate are set out in publications available from P.M.G. radio Branches.

They are:—

(1) an elementary knowledge of wireless telegraphy and wireless t phony and electrical principles.

(2) a knowledge of such of the Ra communication Regulations the time being in force under Telecommunication Convention related to the operation of amat stations.

(3) ability to send correctly, and receive correctly by ear in Mo Code, a test in plain language, cluding figures, at a speed of words per minute.

THE EXAMINATION

The examination to prove these qu fications is in three sections as follo

SECTION K. (REGULATIONS). half-hour written examination consist of one paper containing questions ba on the "Handbook for Operators Amateur Wireless Stations" issued the Postmaster-General's Department.

SECTION L. (TELEGRAPH TESTS). (a) One morse test covering correct transmission of text in pl language—including figures—at a sp of fourteen (14) words per minute. Se ing test 2½ minutes.

(b) One morse test covering the corr reception by ear of text in plain lan age—including figures—at a speed fourteen (14) words per minute. Rece ing test 5 minutes.

In both the above tests the text erages five characters to a word, ea figure counting as two characters.

SECTION M. (THEORY). A two a a half hour written examination of paper containing questions based on theory of wireless telegraphy and wi less telephony as applied to amat transmitting and receiving systems, the elementary theory and practical plication of the principles of electric and magnetism.

In order to gain a pass, a candid must obtain at least 70 p.c. of the to marks allotted in each section.

There is also a limited A.O.C.P. c tificate which does not require the ca didate to have passed the telegrap tests. (Section L).

The limitation is that transmissio must be confined to the amateur ban at 50 Mc. and higher.

LIMITED LICENCE

This certificate will be of interest many technicians who have a go knowledge of radio theory but who not have the time to reach the necessa standard in Morse. An unrestricted cence can always be obtained at a la date simply by passing the Morse te

Four examinations are held each ye on the second Tuesday in Janua April, July and October in the capi city of each State and also at Newcast Armidale, Wagga Wagga, Townsvil Rockhampton and Bendigo. When a ca

te nominates the place at which he
d like to take the examination, full
culars of the local arrangements will
orwarded to him.

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in areas away from the cities. A
idate living more than 50 miles
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nge to take the examination under
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ial Post Office nearest to his home.

DIO BRANCHES

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ible from any one of the Radio of-
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lers St., Melbourne, C. 1, Vic.
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bane, Q'ld.
perintendent, Radio Branch, 131
William St., Adelaide, S.A.
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h, W.A.
perintendent, Radio Branch, Tele-
ne Building, Harrington St., Hobart,

istrict Radio Inspector, Radio
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istrict Radio Inspector, Radio
ch, Wagga Wagga, N.S.W.
istrict Radio Inspector, Radio
ch, Armidale, N.S.W.
istrict Radio Inspector, Radio
ch, Room 23, Allans Walk, Pall
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io Branch but to the Controller,
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rne. The application must reach Mel-
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th before that set down for the
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E LIMITS

pplications to sit for the examinat-
will be accepted only from people
years of age or older and an of-
l copy of the applicant's birth cert-
te plus an entrance fee of £1 must
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mination, you can apply for your
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eight, Colour of Eyes, Colour of
r, Complexion and any special pecu-
ties. At the same time a recent head
shoulder photograph about 3in by
is required and this photograph
uld be autographed on the front.

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r 16th birthday, you will be required
wait until that date before the cer-
ate is issued.

he bare outline of the requirements
not really give you a very good
of how to start studying for the
mination. Copies of previous
.C.P. papers can be obtained from
io Branch offices at 6d per set and
ould be well worth investing in sev-

A.O.C.P. THEORY TEST, OCTOBER, 1957

Seven questions to be attempted—equal marks for each.

1. (a) What causes "Key Clicks"? Describe, with the aid of diagram, how this type of interference to broadcast reception may be reduced or eliminated.
2. (a) Explain, using sketches, two methods of matching a half wave centre fed aerial to a transmission line. Show the current and voltage distribution.
   (b) Why is it important to correctly match line to aerial impedance? What effects can result from mismatching?
3. Having a zero to 1 milliampere meter with internal resistance of 100 ohms describe how you would adapt this instrument to read the following:—
   (i) up to 500 volts d.c:
   (ii) up to 100 milliamperes d.c.
   Show component values in both cases.
4. What do you understand by the following definitions relating to Frequency Modulation:—
   (i) Modulation Index, (ii) Deviation Ratio, (iii) Frequency Deviation (iv) Frequency Swing?
5. (a) Draw circuits of a crystal oscillator and a variable frequency oscillator capable of being used by an amateur station.
   (b) Explain the theory of operation of each type and state what particular advantage and disadvantage each possesses.
6. What are lecher wires? Describe, with the aid of a diagram, how you would use these to measure the frequency of a transmitter operating on 144 megacycles.
7. (a) Using diagrams, explain the principle of operation of a crystal microphone. Show how you would connect this to the input of a microphone amplifier. Give resistance values.
   (b) Why is it necessary to carefully shield the microphone leads and transformer used with a moving coil or ribbon microphone?
8. Explain with the aid of a diagram how high tension supplies for a receiver or a transmitter may be obtainedr from a battery and a vibrator
9. What do you understand by the following terms used in ionospheric investigations:—
   (i) Critical Frequency. (ii) Maximum Usable Frequency (iii) Optimum Working Frequency. (iv) Sporadic E. Layer.

Our answers will be published in next month's issue.

eral sets. From the same source you can get the "Handbook for Operators of Amateur Wireless Stations" which is essential for Section K. (Regulations) of the examination.

For the theory section of the examination we recommend that you obtain a copy of the latest edition of "The Radio Amateur's Handbook" published by the American Radio Relay League. This is one of the best books ever published from the amateur point of view and you will find practically all the theory you will need for Section M. presented in clear and concise fashion. Space is devoted to descriptions of amateur equipment. You will find these parts of immediate interest to support the theory, and later a valuable guide to constructing your own station.

Other books which are officially recommended are the "Radio Handbook" by Editors and Engineers Ltd., "The Amateur Radio Handbook" by Incorporated Radio Society of Great Britain and "Microwave Techniques" also by the Radio Society of Great Britain.

BOOKS TO STUDY

For the electrical theory which forms part of the Section M. paper certain Paragraphs of the Admiralty Handbook of Wireless Telegraphy, 1938, Volume 1 are officially recommended. They are: 23-71, 76-89, 101, 102, 107-140, 145-149, 151, 153, 164-167, 169, 175-180, 182, 184-189, 278-282, 289, 290, 306, 332, 333, 349-352, 354, 360, 363, 367, 368, 371-385, 387-389.

Unless you have plenty of money to spend, we suggest that you start with the A.R.R.L. Handbook and consider the other books as extras later on if you need them. The treatment of basic electrical theory in the Admiralty Handbook is more detailed, but we feel that most readers would get more from the latter after some aquaintance with the amateur book.

There is a great deal of literature available from valve companies at little or no cost. It is well worth while having a valve data book, at least, available so that you can check theoretical points with practical valves and circuits.

The programme of study you set yourself will depend on how much previous knowledge you have of the subject. There are courses leading to the amateur certificate at some of the radio colleges where you will cover the entire programme in a set time. Provision is also made for regular Morse instruction so that you can progress to the required 14 w.p.m in both receiving and sending

STEADY PROGRESS

By following a recognised course you can be sure nothing is left out and it should ensure that you do progress from week to week. There is a tendency when studying on your own to think you understand things when you have, in fact, only a sketchy outline. Some students become disheartened when working alone for long periods, and it does help to have some sympathetic assistance from a qualified tutor or from another interested amateur

You can become proficient at Morse by working on your own and listening to some of the slow Morse stations. It may even be possible to buy recordings of slow Morse for practice. There is every advantage, however, in having assistance from someone who is already proficient, particularly in the matter of sending, because you can easily develop bad habits which are hard to eliminate

(Continued on Page 127)

Aligning a dual-wave superhet receiver. The tuning coils in this case are mounted in a dual-wave coil "bracket" and the trimmers for the respective aerial, RF and oscillator coils are mounted on top of the chassis. Note the alignment tool, a commercial type with a body moulded in plastic and two metal tips, one like a screwdriver, the other slotted to suit miniature coils and transformers.

How to Align Superhet Receivers

Although treated as a separate instalment, this article is really a continuation of part 13, being a discussion of the whole question of receiver alignment. The emphasis, this month, is on superhet receivers, with some preliminary remarks about automatic volume control and instability.

MOST of the old-style TRF receivers, which would have been covered by last month's discussion, employed ordinary manual gain control. In such receivers the gain is directly and only dependent on the setting of the volume control potentiometer, this latter usually serving to vary the cathode bias on one or more early stages.

Any adjustment during alignment, which changes the gain of the receiver, increases or decreases the volume of the signal by an equivalent amount, and the effect of any such adjustment can therefore be discerned readily.

Not long after the general adoption of the superhet principle, designers began to adopt also the technique of Automatic Volume Control, and "AVC", to use the popular abbreviation, is included in nearly all modern receivers as a matter of course.

CIRCUIT IS SIMPLE

In an ordinary broadcast receiver the AVC circuit is usually fairly simple. Negative voltage, developed by the detector across its load resistor, is fed back as a bias voltage to the grids of one or more valves in the tuning section —RF amplifier, converter or IF amplifier.

On weak input signals, very little bias is developed by the detector or fed back to the controlled grids, so that the early stages operate at almost full gain.

REDUCES GAIN

With stronger input signals, however, the detector develops more negative voltage and, this, fed back to the controlled grids, reduces quite drastically the gain or amplification of the relevant valves.

As a result of this quite automatic action, the receiver operates at full gain for weak signals but at much reduced gain for stronger signals. "Blasting" and overload effects are largely eliminated, with at least some of the fading experienced when listening to distant signals.

A volume control still needs to be provided, of course, but it normally operates in the audio system. It allows listening volume to be set to the required level and adjustment to be made for any residual difference between weak and strong signals, not fully compensated by the AVC system.

AVC can be used with either a T or a superhet circuit and has muc recommend it from the user's poin view. However, it does complicate a ment somewhat and for a fairly ob reason

With the receiver tuned to any input signal, the AVC voltage attai level depending on the strength of signal and the gain of the receiver.

Now, if adjustment of a trim should increase the effectiveness tuned circuit, the resulting incre signal at the detector will produce negative AVC voltage. This will dec the gain of the valves, making the of the trimmer adjustment much apparent than it would otherwise be

Conversely, an adjustment w reduces the effectiveness of a tuned cuit will also reduce the AVC vol and allow the valve gain to rise in sequence.

MUCH LESS OBVIOUS

In other words, an AVC circuit receiver tends to mask the effect of adjustments, and quite substa changes in the efficiency of a tu circuit through peaking might make a slight audible difference in the l speaker output.

The best way to counter this mas effect is to align such a receiver on weak signals, as from distant trans ters. Unfortunately, during eve hours, when most homebuilders w want to work on a receiver, ther often a hopeless confusion of weak nals between the strong locals, mos them subject to fading effects which be most misleading.

If the constructor has to rely on tions for alignment, the best plan i carry out a rough alignment proce on local stations to make the dial t correctly, leaving fine adjustment of trimmers, etc., to some daylight pe when it should be possible to pick a couple of weak but steady signal the respective ends of the band.

Out of all this comes another go rule of alignment:

Peak all receiver circuits as f as possible on weak input signal advancing the volume control, necessary, to make them audible.

So much for AVC action and its c plicating effect on alignment. Now a few words on INSTABILITY.

In a well-designed receiver it is sible to peak all adjustments for timum performance, without any s plication arising. Each adjustm merely increases the gain and sensiti till it reaches the maximum of wh the set is capable.

WHY SETS OSCILLATE

In some cases, however, poor des wrong choice of components, wr placement or long active leads allow an excessive amount of sig from one or more stages to couple an earlier point in the circuit, produc a feedback or regenerative effect.

As the gain is increased by progres adjustment, the receiver may sudde

me unstable or "burst into oscilla-
," to use another very common
se.

scillation in a large receiver sounds
h the same as oscillation in a small
nerative receiver, except that it is
duced deliberately in the latter case
controlled by the "reaction" knob.
stead of the station signals being
d clearly, each one is accompanied
even blotted out by a loud whistle
ch varies in pitch as the set is tuned
ss the carrier.

lany superhets produce faint whistles
dd stations, particularly when oper-
g near powerful transmitters. They
fairly distinct, however, from the
ng whistles on every station produced
instability. And while a set is un-
le, complete alignment is impossible
he cure for instability in most cases.
lves elimination of the cause—im-
ed design of the circuit is of doubt
origin, use of the proper components
earrangement of the wiring and lay-

TIAL CARE

leedless to say, this is good argu-
it for care in the first place, when
ding a receiver, whether it be a TRF
superheterodyne. So much, then, for
ability or oscillation.

he basic principles of a superhet re-
er have been explained in an earlier
ter and do not require further
oration here.

is sufficient to recall that the in-
ing signals are passed through a
ventional aerial (and possibly RF)
, then heterodyned with a signal
n a local oscillator stage to produce
esultant known as the intermediate
uency.

latters are arranged so that each in-
ing signal, as it is tuned, is changed
the one intermediate frequency —
ally 455 Kc. All transformers in the
amplifier section therefore need to be
ked to this figure.

ortunately, the task of aligning a
erhet receiver is not as difficult as
ight appear at first encounter and a
ne constructor can do a passable job
alignment without instruments and
out help, provided a certain routine
ollowed.

ere it is, as set out in a special
cle published on the subject some
e ago:—

RST TEST

Connect the set up to an aerial and
th, preferably the ones with which it
to be used, connect the speaker and
ch the power on. Tuning across the
d, you will probably be able to hear
te a few stations, if the set is all in
ler, apart from alignment.

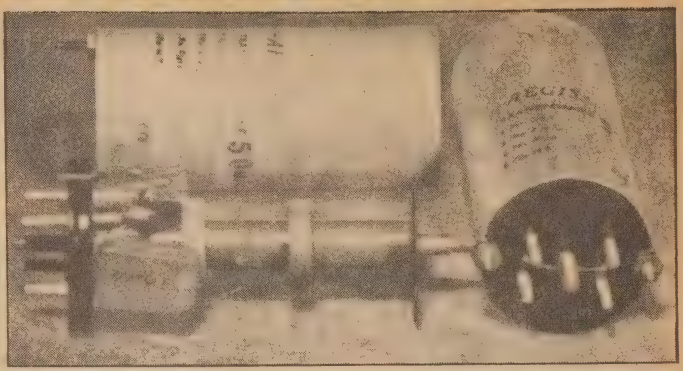
Try to find a weak but steady station
ar the low frequency end of the band.

Tune the receiver as accurately as
ssible to the station you choose. The
st way to do this, or in fact to make
y of the adjustments about to be
scribed, is to rock the setting back-
rds and forwards over the correct
int gradually converging on it.

You can now adjust the IF trans-
mer cores or trimmers as the case
y be (most modern IF transformers
ve core adjustments) for maximum
nd output from the speaker.

It is possible that what was previ-
sly a weak signal now becomes a
ong signal as the sensitivity of the

TWO TYPICAL IF TRANSFORMERS



A couple of typical IF transformers, neither very modern nor very ancient, one dismounted to show the windings. IF transformers should always be peaked with the cores towards the end of the former, not projecting too far between the windings.

receiver rises. This being the case, do the best you can on the original station, and then tune accurately to a weaker adjacent station and go over the procedure again.

The IF windings do not usually need to be peaked in any special order but be sure not to miss any. There may be a slight amount of interaction between the adjustments so it is a good idea to go over the IF adjustments a second time.

MOSTLY 455Kc.

When you have finished with the IF transformers they should be fairly close to the nominal frequency. This is 455 Kc for most receivers nowadays, but occasionally you will strike a receiver with a different arrangement.

For this method of alignment it doesn't matter and, further, even if you do finish up a few Kc off the specified frequency, it will not be serious. The main thing is that all IF circuits be accurately aligned to the one frequency

Having satisfactorily completed the alignment of the IF amplifier it remains to adjust the aerial and oscillator circuits.

By the way, if your receiver has an RF amplifier stage, the adjustments for the RF coil are exactly the same as for the aerial coil.

With most modern receivers the adjustments consist of trimmers and variable slugs associated with both aerial and oscillator coils, and the padder capacitor is a fixed mica type.

You may be called upon to re-align an older receiver with coils of fixed inductance and variable padder, so we will describe the procedure later.

In the case of the variable slugs, tune to a station which you can easily identify toward the low frequency end of the band and adjust the oscillator coil slug until the station coincides with its position as marked on the dial.

OSCILLATOR TRIMMER

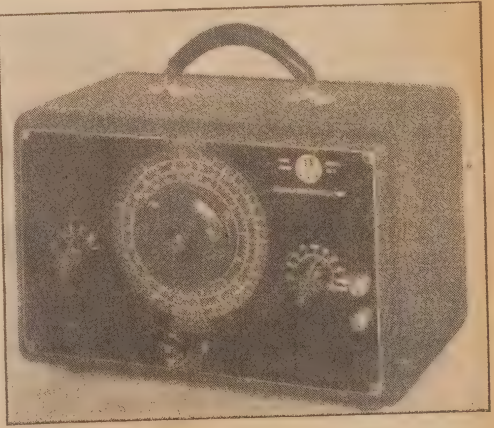
Then tune to a station toward the high frequency end of the band and adjust the trimmer associated with the oscillator section to bring this station to its correct position on the dial.

Repeat the above adjustments a couple of times because each adjustment does have some effect on the other

If everything is in order, i.e., the dial and tuning capacitor correctly matched,

☆

A typical commercial modulated oscillator of the type commonly used by radio servicemen. The knob on the left selects the frequency band the main dial indicates the exact output frequency while the knob on the right controls signal output level. The knob at bottom centre is off-on, and modulation control



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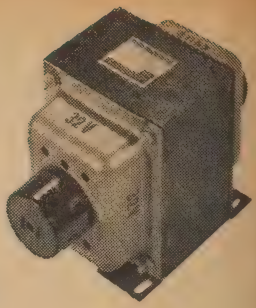

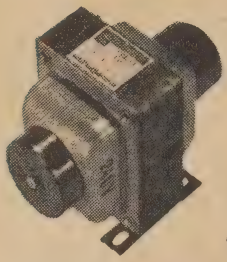

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- Attractively finished in grey hammertone and black
- Supplied in strong individual cartons

TYPE NUMBER	PRIMARY	SECONDARY	Overall dimensions—inches			APPROX. WEIGHT
			HEIGHT	WIDTH	LENGTH*	
TS32/60	240v-50cps	32V-1.9A-60V.A.	3¾	3⅛	5¾	4¾ lbs
TS32/125	240v-50cps	32V-3.9A-125V.A.	4½	3¾	6¾	9 lbs
TS32/200	240v-50cps	32V-6.25A-200V.A.	4½	3¾	7½	12½ lbs

* Length includes input connector and outlet socket

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ations should now coincide with
narked positions on the dial.
uld the AVC system tend to make
ong local stations appear broad it
be in order to remove the aerial
rate the set with a short length of
while making the adjustments to
ation positions.
ally, the aerial coil slug and the
trimmer should be adjusted to
the strongest signals. The slug
ment should be made with the re-
tuned toward the low frequency
f the band and the trimmer adjust-
toward the high frequency end.
aerial circuit should preferably
justed with the aerial with which
eceiver is to be used connected,
t is a good idea to go over it
l times to make sure that you get
st results.

KING ON NOISE

this time the set will probably be
ensitive, and you may not be able
d exactly the sort of signal you
re. In this case it is quite in order
ne the set off a station and adjust
e greatest noise output.
e procedure is a little different if
re called upon to realign an older
er which is fitted with a variable
r capacitor. The inductance of both
and oscillator coils will most prob-
be fixed.
e first thing to do after adjusting
F transformers is to tune to a weak
teady station toward the low fre-
y end of the band and then find
tting of the padder capacitor which
the loudest signal. Unfortunately,
time you shift the padder, the
on of the station alters.
e job is made easier if you hold the
ment tool in one hand and the tun-
nob in the other so that you can
the tuning capacitor backwards and
rds over the station while the
er is being adjusted.
e grub screw securing the dial drum
e capacitor shaft should then be
ned and the pointer made to coin-
with the station's position on the

the high frequency end of the
., the two trimmer capacitors are
ted as before, the oscillator trim-
being used to control the calibration
the aerial trimmer to give the best
tivity.

ECT OF AERIAL

odern aerial coils are designed so
the alignment is little affected by
erial be it long or short, but some
e earlier aerial coils may not be
e reproach in this respect and in
ase we suggest that you do the final
stment of the aerial trimmer with
aerial connected.
o this point we have spoken only
he broadcast band. The procedure
the shortwave band or shortwave
s is essentially the same, but there
e added difficulty that it is often
to find and identify a suitable
on for alignment.
Conditions vary a great deal, and
times change within a matter of
utes. Therefore, do not be discour-
e if first results are not very satis-
ory. Of course, the aerial is more
rtant than in the case of the broad-
s band, because you frequently wish
isten to very weak signals.
owever, most of the main short-
e stations of the world are heard very strongly in Australia, and even a poor aerial will often receive them at considerable strength.

As a first step, we suggest that you leave the shortwave oscillator coil slug at its original factory setting. The aerial slug (and RF slug, if fitted) should then be adjusted for the loudest signal, or background noise, at the low frequency end of the range. Now set the trimmer capacitor across the oscillator section to about the middle of its range, and with the set tuned to the high frequency end of the band, adjust the aerial trimmer for greatest output on noise or a signal.

The calibration can be checked later by noting the positions of stations of known frequency.

Toward the low end of the band use the oscillator slug for adjustment and toward the high end of the band the oscillator trimmer, always bringing the aerial circuit into line after an alteration has been made.

This use of the slugs for low frequency adjustment and the trimmers for high frequency adjustment is a rule you should apply when lining up any of the RF circuits.

FREQUENCY CHECK

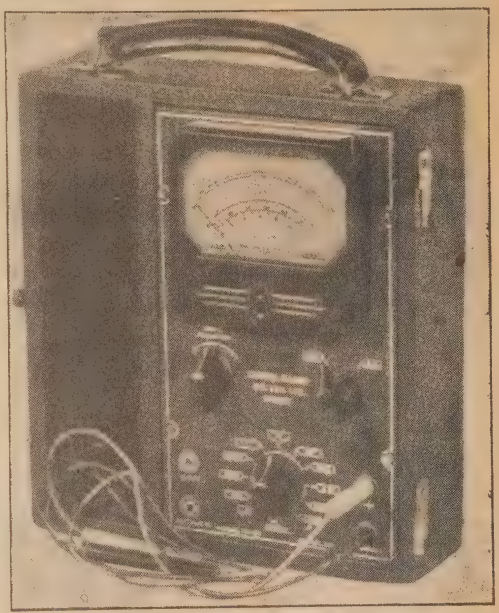
An excellent frequency check with an extremely high order of accuracy is the American station WWV. It transmits on a number of frequencies, but those most likely to be heard in Australia at good strength are 5.0 Mc, 10 Mc and 15 Mc, or 60 metres, 30 metres and 20 metres respectively.

The signals can easily be identified by the 440 and 4,000 cycle tones which are superimposed on the RF carrier and the fact that the tones are interrupted by a one-second pulse. The pulse is omitted on the fifty-ninth second of every minute and there are other interruptions at regular intervals for call sign announcement and other purposes.

Carefully carry out the procedure we have described and there is every chance that your set will perform very much better as a result of your efforts.

If suitable test instruments are available, of course, a more precise job can be made of the alignment. As we said earlier, we are not so much concerned in this article with readers who are sufficiently advanced to own or have access to test instruments, but a brief explanation may help the beginner understand what it is about.

The most instrument for align-



Not the latest model by any means but nevertheless a fairly typical kind of multimeter. At the bottom left of the panel is a pin-jack marked "OUTPUT V", which is connected internally to the AC Volts terminal by a capacitor. By plugging the leads into the "Common" and "Output V" jacks and connecting to the receiver's output circuit, the meter will read proportionately to the loudness of the test signal heard from the loudspeaker. An output meter can only be used in this way with a test signal, not a regular station transmission.

ment is a service oscillator or the more elaborate instrument which usually goes under the name of a signal generator. These instruments can produce radio frequency signals anywhere in the spectrum required for alignment and the strength of the signals can be controlled by turning a knob on the front panel.

The signal is modulated usually by a 400-cycle tone so that when reproduced by the receiver a single whistling note is heard from the loudspeaker. With a signal thus available at any desired frequency, at any desired strength, and producing a constant output tone, alignment is much simplified.

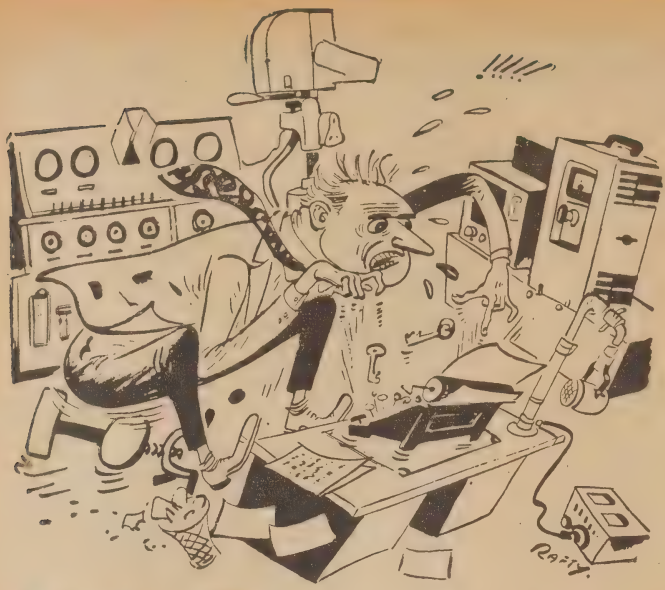
Almost invariably the "output" range of a standard multimeter is used in conjunction with an alignment oscillator. The leads from the multimeter are clipped across the voice coil wires or between the output valve plate and either B-plus or earth.

METER READING

By suitably adjusting the meter range it is possible to have the meter read proportional to the strength of the tone issuing from the speaker. The effect of adjustments can thus be noted on the meter, the indication being quite clear on changes in level too slight for the ear to notice.

The alignment procedure for a TRF using these instruments is very simple. The oscillator is set to produce a signal at about 600Kc and the signal

(Continued on Page 123)



And if the cameras also showed
parations for the play to follow, it
surely have focused viewers' atte
on the dramatic product of all this
anical and electrical paraphernalia

The irony of the situation is
television stations, and the A.B.C
particular, have screened an enor
number of documentary films, ex
ing the technicalities of this, that
the other. Plenty of viewers seem t
them interesting, even if only
a change from other fare.

Then why be coy or modest
ticent about the technicalities of
vision, which is at least as inter
and a good deal more topical just
than most other such subjects?

PLENTY TO INTEREST

Am I being unrealistic to suggest
not one but several short and int
ing features could be built around
modern television station—the st
transmitters, links and O.B. vans at
how variety shows are built an
hearsed, "a play is born" and all
studio tricks, like sound effects,
mixing and such like.

What about it then?

And what about the play which
lowed the opening ceremony ref
to earlier? No, I've no intentio
turning drama critic, but it did
me furiously to think!

Let's Buy An Argument

Arriving home, the other evening, I served notice to all and sundry that, come what may I wanted to view the opening on TV of the new ABN studios. I hoped that, along with the inevitable speeches, they would present a quick camera tour of the building, with some explanation as to what it was all for.

MAY I add that, in a strictly non-technical household, I was not alone in this hope.

But, as you possibly observed, the A.B.C. had different ideas. As the speeches went on and on, the allotted programme time ticked away and the only concession to those interested in technicalities was the transmission of a couple of still photographs, posed two nights earlier with everything in place and not a soul in sight.

PLAY TO FOLLOW

Apparently their idea was that the spaciousness and versatility of the new setup would be amply demonstrated by the play to follow—a rather forlorn hope, I fear. To me, the play was a demonstration of something else altogether but that's another story.

Is it that television people are so close to their own medium that they can't possibly imagine anybody being interested in its technicalities?

Do they think it's too complex for satisfactory explanation or do they fear that it would be a bad thing psychologically to explain some of the gadgets they use to create illusions on the screen?

Only a dolt would have expected the A.B.C. to have eliminated the speeches or the references by the compere to more and better programmes etc.

But how much all of this would have been underlined by the simple act of using the cameras to show what was happening at that very instant around the studios.

Naturally, a lot of people would have been very busy about their own tasks, pushing mic. booms around, manoeuvring lights and so on. But what an opportunity to grab one or two of them, by prearrangement if need be, and have them explain their job.

by Neville Williams

Admittedly I haven't seen
studio plays and admittedly the a
Australia is new, but those I have
have struck me most by their artif
ity. "The Multicoloured Umbr
was no exception.

Lines didn't always carry the
inflection. Characters didn't al
remember the exact degree to w
they should have been drunk or inj
or emotionally distraught. Points in
story didn't get just the emphasis
they deserved.

POOR PRODUCTION?

This could be dismissed summaril
poor production. More charitably
might be considered as the likely r
of anything but the most elaborate
costly effort to give a single, word-pe
performance, before a huge yet int
ible audience.

There is no producer to shout "
if something goes wrong; no opportu
to remake and to splice in that i
ment of a scene which spoils the wh
no second chance for the actor
collapses (as actually happened) fro
blow which never landed.

a theatre presentation there is some
nce of such accidents. The atmos-
and expectation of the audience is
ent. And since the play may
or months, only a minute portion
ne total audience ever sees any
untoward incident.

: when a play is presented live on
sion, it loses this tolerance, this
ction. It shares the same medium
nvites direct comparison with films,
their greater versatility, their more
ely production and their terrific
tage in respect to retake and edit-

at kind of a film would we get
inging together the first efforts of
ar idols, playing scenes straight
the scriptwriter's pen and minus
fterthoughts of cutting and editing.
this isn't too far removed from
nditions under which a TV studio
must be presented.

' LIVE PLAYS?

ried to its logical conclusion, this
es an argument for discarding
plays altogether; for switching
tely to film or tape techniques.
ost of the medium might easily be
ore than the cost of intensive
sal for one word-perfect presen-
—and the result better.
i the price? The loss of "theatre,"
stained dramatic performance as
whole play is cut up into little
, to be strung together by an inter-
by an editor with a pair of
's.

is an editor an interloper? May
t be as much an artist, as much
tributor to the end dramatic result
writer, the producer, the director,
tor?

re's plenty of room here for argu-
and discussion. The A.B.C. has
sed its intention of producing more
ays. It might yet transpire that a
acceptable end result, locally any-
will come from a combination of
dramatic aspirations with modern
logy in the form of prerecording
e or film.

before you prepare to tear me to
, if you feel like doing so, remem-
at I refer to high quality pre-
ed tapes and films, not the dread-
escopes which are peddled around
ace—blurry 300-line copies of a
le screen.

R PRESENTATIONS

I have referred only to plays, not
er and distinct forms of live
ation.

ll this smacks too much of the
critic, I can only apologise. De-
fforts to the contrary, one can't
inking at times beyond the limits
electronic circuit. Back to the
erefore.

ne panel herewith we reproduce a
rom W.H. bemoaning our failure
ot and publicise the idea of nega-
tput impedance for amplifiers.
aps we should pause to explain
ne discussion is all about.

output voltage of a conventional
mplifier is affected to some extent
load connected to it, this being
ly a loudspeaker. If the loud-
's impedance rises at certain fre-
s, the higher load presented to the
er will cause it to show a rise in
voltage in the same region.

NEGATIVE OUTPUT IMPEDANCE

Dear Sir,

Having always regarded your magazine as being reasonably progressive in its field and as having a policy of describing equipment, giving good performance at moderate cost, I have watched for some time in the hope that it would get around to the description of an audio amplifier employing the system variously described as voice coil velocity, feedback and negative output impedance.

In view of the substantial gains to be obtained, particularly with moderately priced equipment (including loudspeaker baffling), the lack of any such development has been a mystery to me. Can it be the result of ultra-conservatism and fear (without trial) of the admitted possibilities of instability that can arise if the negative output impedance exceeds the blocked voice coil impedance?

My own experience is based upon a modest single-ended amplifier first constructed in 1947. This employed a fairly conventional 2-stage amplifier driving a standard 12-inch loudspeaker mounted in a typical radiogram cabinet, the output transformer being an ordinary type supplied with the loudspeaker. The amplifier consisted of a 6J7-G driving an EL3NG operating into a primary impedance of 12,000 rather than the more usual 7,000 ohms in order to achieve a relatively high loop gain for the two stages.

COMBINED FEEDBACK

Combined negative voltage and positive current feedback from the voice coil circuit to the cathode of the 6J7-G gives the amplifier a negative output impedance in the audio frequency range. Over a 10 year period this amplifier has not developed instability and apparently performs as well as originally, with no valve replacements as far.

The listening quality evokes favourable comment from visitors and is perceptibly better than one would normally expect from such modest equipment. The most noticeable features are good transient response, clear bass reproduction without boom and clear reproduction of orchestral items and speech.

My decision to write this letter was made after recently reading an account of thorough tests of an amplifier of this type at a laboratory subsidiary to the Radio Corporation of America. The amplifier described had an overall distortion level of 1% (perhaps barely sufficient to put it in the high fidelity class).

However, the overall distortion of the loudspeaker and amplifier system, as measured with a ribbon microphone feeding into a total rms distortion meter, was reduced from 22% for zero output impedance to 4% when the amplifier was adjusted so that its negative impedance was equal to 100% of the blocked voice coil impedance of the loudspeaker.

BASS RESPONSE

Equally striking performance was indicated in levelling out the bass resonance and extending the low frequency acoustic response. The circuitry was described as not being particularly critical and the author had this to say—

"The improvement in loudspeaker performance obtainable with this system allows the use of less expensive loudspeakers and small speaker enclosures in high quality sound systems. Because of poor quality of loudspeakers in comparison with present day amplifiers, the use of negative impedance circuit can provide improved performance even with a reduction in quality (and cost) of the amplifier.

Another incidental feature which arises out of the above mentioned report is the use of acoustic measurements of transient response, frequency response and system distortion, rather than the more usual and misleading observations of electrical response for which the main advantage is purely convenience.

Whilst it is true that acoustic measurements are dependent upon the properties of the listening room, there is nevertheless still much to be gained from this type of performance test, particularly in respect to the assessment of non-linear distortion.

Yours faithfully,
W.H.

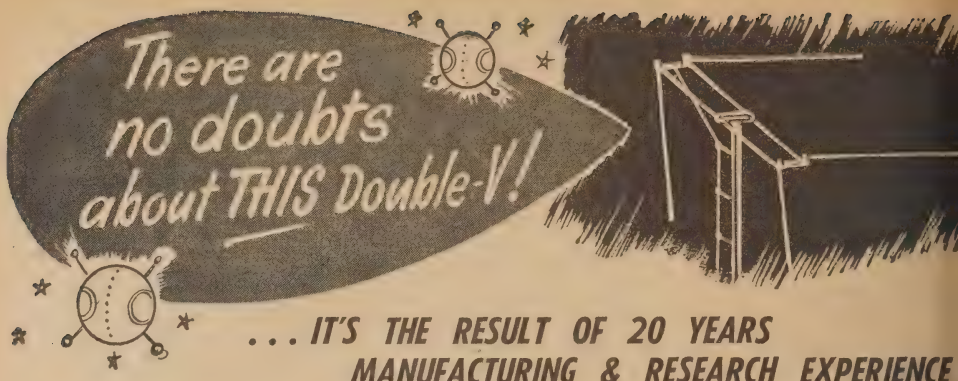
On a graphical basis, this simply means a non-level frequency response with loudspeaker load.

Another interesting effect must also be mentioned. When excited by a sudden impulse, a loudspeaker cone may not immediately come to rest when that impulse is removed, but may continue to oscillate independently for a brief period. In so doing it will generate a voltage, which is fed back into the secondary of the output transformer, then stepped up and applied to the output valve plates.

Although "free-wheeling," the speaker cone comes to rest more quickly than it otherwise would, because some of its energy is thus expended in generating electrical energy, which is dissipated in varying the plate voltage of the output valves.

It can rightly be said that the energy is dissipated into the amplifier's output resistance or, alternatively, that the amplifier's output resistance "damps" free motion of the loudspeaker cone.

Initially, the output impedance of an amplifier is dependent on the natural plate resistance of the output valves, this resistance being stepped down to a much lower effective value, according to the turns and impedance ratio of the output transformer.



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- *Brilliant, unequalled performance—PROVED BY FIELD TESTS BY INDEPENDENT LABORATORIES.*
- *MEASURED RELATIVE GAIN compared with that of half wave-length folded di-poles is; CH2, 1.5 db; CH7 and 9, between 6 db and 7 db. Compare these results with any other published figures and you'll appreciate "Belling-Lee" superiority.*
- *They are easy and fast to erect. Made of high-tensile aluminium alloy, they are EXTRA STRONG; they go straight up and stay up straight. They are corrosion-resistant, with-standing all climatic conditions.*
- *Available in 4 alternative mountings—wall chimney, flat roof or inside roof.*
- *Every aerial is individually tested and GUARANTEED in writing for 12 months, your assurance that when you install "Belling-Lee" your first cost is your last.*

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VEE-ROD DOUBLE-V
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s might be expected, amplifier volt- is less affected by vagaries of the iker load if the output impedance is Also, a low output impedance more ctively damps free oscillation of the e.

ince triode valves have a much lower ral plate resistance than pentodes, were preferred at one time for high ity amplifiers.

ibsequently it was demonstrated that tive feedback could reduce drastic- the effective output impedance of amplifier, so that pentode amplifiers negative feedback also became com- place.

ontinued development has resulted in use of pentodes with very high de- s of feedback, or triodes or valves e "Ultra-Linear" connection, or such all with feedback and designed to very low effective output impedance.

NSTANT OUTPUT

his trend has been carried to the t where a large proportion of mod- amplifiers shows no significant ge in output voltage with any likely ge in load impedance, the frequency onse being substantially flat.

rthermore, their output impedance nly a small fraction of the voice impedance so that a cone, "free- sling" after a sharp impulse, finds working into a virtual short cir-

this point many designers are pre- d to "call it quits" and regard the rifier as "ideal," turning their atten- to ancillaries like speaker and baffle chieve any further improvement in oduction.

it there is another school of thought h holds that an amplifier design can arried beyond this "ideal" in order ompensate for the known limita- of these ancillaries.

ey point out that an external cir- cannot completely "short" the volt- generated by a free-wheeling loud- ker cone. Every voice coil has a ntial inherent DC resistance and limits the damping current which flow, even with the voice coil ter- ls completely shorted.

T REALISTIC

is unrealistic to postulate, they say, a voice coils shouldn't free-wheel and ldn't vary in impedance and ldn't have DC resistance. All kers show these limitations, which further aggravated by the limited ing which most users find it feasible rovide. Why not manipulate the rifier design to offset these limi- ns as far as possible?

ccordingly, some designers have car- the feedback idea a step further to ve not just zero output impedance a negative output impedance!

rhaps you are wondering how?

dinary negative feedback involves g a "sample" of the output VOLT- across the output transformer or circuit and feeding it back in phase sition to the incoming signal at some r point in the amplifier.

e cancellation effect reduces gain, immediate result, but it also re- s harmonic distortion, levels the fre- cy response and lowers the effective ut impedance—the lastnamed being ery desirable features.

The suggested extension of the tech- nique is to sample also the current flow- ing through the load, allowing it to de- velop a proportional voltage across a small resistor. (Connecting a resistor in series with the voice voil is the usual scheme.)

The voltage developed is fed back to an earlier point in the amplifier, phase adding to the input signal and there- fore representing POSITIVE feedback. Now see what happens:

Under reference conditions, the cur- rent through the load and the voltage across the series resistor assume certain values, the voltage being fed back to aid the input signal and give the ampli- fier a certain overall sensitivity.

If the load impedance should rise above reference, current through the load will fall, as also will the voltage across the series resistor. There will be less feedback to aid the input signal, the effective amplifier gain will fall, with a tendency to reduce output vol- tage.

In other words, an increase in load may cause a decrease in output voltage, and vice versa, giving the amplifier a characteristic akin to negative output re- sistance.

Those who think along these lines con- tend that, by combining a discreet amount of negative-voltage and positive-current feedback, an amplifier can be given a negative output impedance equi- valent to the D.C. resistance of the asso- ciated speaker voice coil.

Therefore, as far as damping is con- cerned, the combination will behave like an amplifier with zero output impedance and a speaker with zero voice coil resis- tance.

That's the general picture. Now read the letter from W.H., a man who is obviously very keen on the idea.

At the outset, he suggests that our failureto exploit the circuit may be based on ultra-conservatism and/or a fear of possible instability troubles.

To some extent he's right. We've had enough experience in the home- building game to know that it pays to be moderately conservative. Readers and the trade generally are much happier with a tried and proven circuit that works well, than one which has a pos- sible performance margin but which may be "cranky."

COULD BE CRANKY

Our impression of the positive feed- back scheme is that it could be de- cidedly cranky in the hands of home constructors, though we haven't done any work on it as yet. And this raises a third point which W.H. hasn't men- tioned—time to do all these things.

If we were to maintain a staff large enough to investigate every possible circuit and device from the home-build- er's point of view, we'd very rapidly "go broke." There would then be no magazine, no staff and a lot fewer people interested in the technicalities of radio and allied subjects.

I might even have to work for a living!

This negative R scheme may be thor- oughly commendable or it may be fraught with practical difficulties or it may have very little to offer in terms of the end result. I must say, however, that its continued obscurity as a cir- cuit idea isn't reassuring.

I well know that there is very keen competition on a world-wide basis in the amplifier field and designers would hardly pass up something which readily allows them to meet specifications at a cheaper price or obtain equivalent reproduction from less elaborate cabinetware.

DISAPPOINTING?

It may not be as good in practice as it appears on paper.

Without referring to W.H. in particu- lar or to his information quote, there is a tendency for one to snatch a mental picture from such reading along the lines of . . . "Distortion falls from 22 p.c. to 4 p.c., therefore an amplifier can't be much good without it!"

In point of fact, the test merely shows that a particular amplifier, having an initial distortion of 22 p.c., was greatly improved by the circuitry in question. It does not follow that every amplifier set-up of comparable quality must have this initial order of distortion, nor must they show such a dramatic reaction to positive current feedback.

I'm rather reminded of the retort of my local garageman when asked about a new petrol-saving feature. I quote: "Brother, if you strung all these gadgets together and they all worked as

(Continued on page 119)

TRANSFORMERLESS RECEIVERS

Dear Mr. Williams,

"Death Rides the Cold Chassis" (Let's Buy An Argument, Jan., p 58).

What death? The death of television for those people who cannot or will not pay £200 for a TV set.

As the editor states in the January '58 editorial "A TV set for £120 would have enormous appeal."

I would also include, "and a TV kit set for £80."

A factor in bringing this happy state of affairs about would, of course, be transformerless construction.

Provided adequate precautions are taken there should be no fear of a rising death rate.

Precautions which would be of value are:

1. *Methods of construction which have a bearing on safety should be devised by an electrical engineer with experience of high voltage power apparatus and not by "radio types" who do not know the meaning of high voltage insulation.*
2. *All control shafts extending from the chassis to be of insulating material.*
3. *Transformerless sets to be fitted with plug, socket and neon pilot light and a notice stressing correct usage.*
4. *Insulating chassis sections, coil and transformer shields etc. to be used where possible.*
5. *External isolating transformers to be used for quantity testing.*

Yours sincerely,
M.G.

offering you the widest range of pick-ups . .

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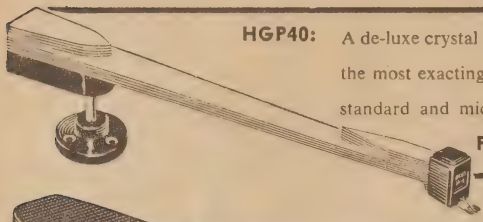
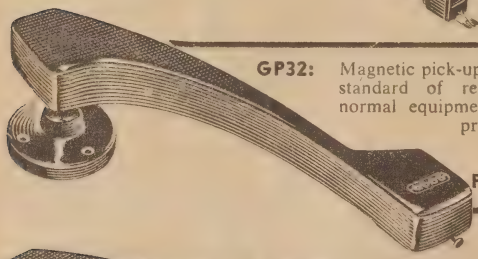


HGP40: A de-luxe crystal pick-up to satisfy the most exacting. Complete with standard and microgroove heads. **PRICE, £9/15/-**



GP32: Magnetic pick-up provides a good standard of reproduction with normal equipment at reasonable price. Output voltage, ½ volt at 1,000 c.p.s. **PRICE, £2/12/6**

HGP38: A crystal pick-up. Incorporates the HGP37 turnover cartridge for standard or microgroove recordings with cantilever stylus. **PRICE, £5/15/-**

GP50: Is a HIGH-OUTPUT crystal pick-up suitable for reproducing standard and microgroove records through *low-gain* amplifiers as used in small record players and some radios **PRICE, £4/19/6**

GP60: Incorporates the latest-type CERAMIC cartridge—unaffected by heat or humidity. For use in tropical areas. **PRICE, £6/16/-**

GP10: Is a crystal pick-up utilising the GP9 cartridge, combining purity of reproduction with extreme reliability. Resonance-free response from 50/8,000 c.p.s. Output, 1.5V at 1,000 c.p.s. **PRICE, £3/12/6**

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Designed to meet the most exacting requirements of modern recordings — low element mass and very high compliance enables the heaviest modulation possible to be traced with a minimum of record wear. Both standard and L.P. heads available. **PRICE, £3/12/6**

GP9 CARTRIDGE

Now famous as the cartridge with the unbreakable crystal. Takes standard steel or fibre needles for 78 r.p.m. records. **PRICE, £1/11/6**

GP59 CARTRIDGE
A HIGH-OUTPUT cartridge suitable for reproducing standard and microgroove records through low-gain amplifiers. **PRICE, £2/3/-.**

CARTRIDGE GP61

A CERAMIC cartridge that will withstand the rigours of a tropical climate and is, at the same time, very robust. **PRICE, £3/19/6**

HGP37 CARTRIDGE
A TURNOVER cartridge with cantilever stylus that utilises a new method of crystal drive, a bisectional control element that achieves independent characteristics for standard and microgroove. **PRICE, £2/18/6**

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NEW BOOKS

sistor simplified

ANSISTORS WORK LIKE THIS, . Larsen, published by Phoenix Ltd., London. Stiff cover, 64 10in by 6in. Illustrated by line ngs.

ected at young people of about school level, this book sets out in style to tell what a transistor is, how it works, and what can be with it. Historical snippets woven he text supplement the technical nation and help to enliven the dis- n.

chapter shows how to build a receiver, transistors for which are ible in this country. Some com- ses in performance are made in terests of simplicity, but no doubt younger readers would gain a good f experience from building the set.

copy from the Technical Book Magazine Co., 295 Swanston Street, urne. The price is 12/ plus 1/ e and packing. (M.V.F.)

iery receivers

Y BATTERY RECEIVERS WITH NATURE VALVES, by E. Roden- Philips Technical Library. Hard e 242 pages, 9in x 6in with 227 ations and 8 folding diagrams.

i book is mainly a comprehensive ion of miniature battery valve Information of the DL94 (3V4) covers 27 pages and includes 37 f curves enabling the designer to t the performance of the valve e practically any conditions.

minor disadvantage in this country European type numbers are given signers should have no difficulty ognising local types. Also valves 5 mA filaments, to which a whole r is devoted, are not normally used is country.

blems peculiar to dry battery re- , for example, common coupling en successive stages with filaments es are discussed in very great de- d many points of design essential ability in service are brought for- d

final chapter is devoted to cir- escriptions of seven battery oper- eceivers ranging from a 4 valve 7 valve AM/FM receiver of high mance.

book is a store of technical in- ion for the design engineer or ed experimenter.

copy from N.V. Philips Gloei- fabrieken, Eindhoven, Holland. distributors are Philips Electrical ries Pty. Ltd., 63 Clarence Street, y, and the price is 32/6 (M.V.F.)

How to install aerials

RECEIVING AERIAL SYSTEMS, by I. A. Davidson, B.A., published by Heywood and Co. Ltd., London. Stiff cover, 152 pages, 7½in by 5in. Illustrated by line drawings and photographs.

Properly engineered receiving aerials are becoming increasingly important as the use of very high frequencies for broadcasting and television becomes more widespread. The "wire around the picture rail" technique is no longer always satisfactory.

Most existing works on the subject of aerials discuss them as part of a complete communication system. The author of the present volume has approached his subject mainly from the point of view of ordinary domestic installations. One of the chapters is devoted to the mechanical design of aerials suitable for erection around a house.

Opening chapters deal with fundamental concepts, the special aerial terms such as gain, impedance, and so on, being explained. The essential formulae (by no means frightening) for solving your own aerial problems are included.

There are a total of 12 chapters, including those on "The Half-Wave Dipole," "Radio Frequency Cables and Accessories," "Installation Of Aerials" and "Measurement Of Aerial Characteristics."

We feel that the book is an excellent practical volume for the serviceman and technician called upon to instal aerials but who does not have the time to wade through the highly technical literature already in existence.

Our copy from the Technical Book and Magazine Co., 295 Swanston Street, Melbourne. The price is 34/9 plus 1/3 postage. (M.V.F.)

Transistor audio

TRANSISTOR A.F. AMPLIFIERS, by D. D. Jones, M.Sc., D.I.C. and R. A. Hilbourne, B.Sc. published for "Wireless World." Hard cover, 152 pages, 8¾in x 5½in, illustrated by 94 line diagrams.

The recent work of two members of the research laboratories of the General Electric Co., the book deals with the fundamentals of transistors, the design of audio frequency amplifiers and gives practical examples of the transistor amplifiers ranging from hearing aids through high quality types to a 20 watt public address amplifier.

The information is presented with as little algebra as possible and will appeal to the practical radioman anxious to become familiar with transistors as painlessly as possible.

Naturally enough, the practical examples refer to the General Electric Company's own "GET" series of transistors. Few transformers suitable for transistors of any sort are available commercially and the winding data provided will be found useful.

We have received copies from both the publisher, Iliffe and Sons Ltd., London and the Technical Book and Magazine Co., 295 Swanston Street, Melbourne. The local price is 34/9 plus 1/- postage and packing. (M.V.F.)

The RADIOMASTER

RADIOGRAM CHASSIS . . .

A great performer on Radio and Records

HI-FI MODEL E22 reproduces perfect high treble notes and bass notes without "drumming" or distortion—brings recorded sound to your home as near as possible to the original. A high gain R.F stage ensures satisfactory long distance radio reception regardless of location. Features include:—

- *Treble and bass boost with separate controls*
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- *Latest type Radiotron valves.*
- *Custom built — six months' guarantee*
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- *Design tested and approved by the Valve Application Division of Amalgamated Wireless (A'sia) Ltd.*

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Magic Eye tuning indicator 30/- extra. Packing included. Freight extra.

Other Radiomaster Radiogram chassis are available from **£23/5/-**

Write for particulars.

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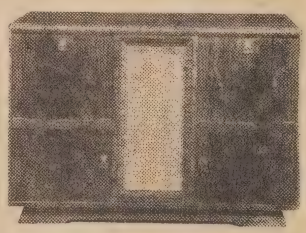
RADIOGRAM CABINETS



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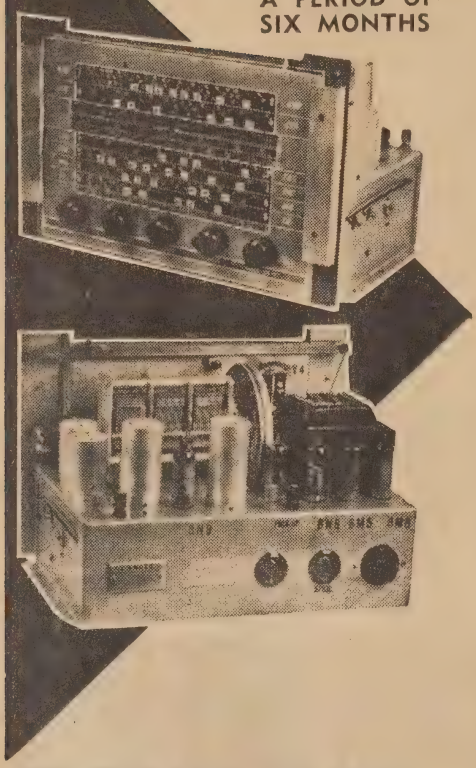

NEW:

Ultramodern circuit using nine high gain valves including "magic eye" indicator. Permatuned iron cored coils and intermediates giving excellen state reception and a short wave range of 12,000 miles. All valves u the new Mullard nine pin Innoval series.

NEW:

Tone control and audio stages incorporating the Mullard 5/10 amplifier with separate bass and treble controls giving plus or — 15 db. boost at 50 cycles L.F. and 10,000 H.F., combined with push-pull outpu inverse feed-back gives you really high fidelity reproduction from you or favourite recordings.

NEW:

Dual Speaker combination, using a heavy duty woofer (12in M.S.P. Jense special) with matching 6in tweeter and cross-over network giving a fre response of 46 to 13,000 cycles. Speakers are mounted coaxially maki one 11in mounting hole necessary.
If required the new Magnavox high-fidelity twin coned speaker can be su

NEW:

Large calibrated edge-lit dial in plate glass (11in x 7in) with main stat each State in prominent type. Dial fitted with counterweight drive, giving tuning. Indicator lights are fitted showing which band is in operation. can be supplied in cream, black or brown with matching knobs and escutc suit contemporary blond or walnut finished cabinets.

NEW:

Sensitive "magic eye" tuning indicator (EM80) making tuning simple an tive even on interstate, overseas and country stations.
All chassis are wired for the fitting of an F.M. tuner or tape recorder, plug being provided on back of chassis, also pick-up terminals and out gramo motor.
Power switch is fitted to volume control, radiogram switch, combined wit change switch. Audio end of set can be used with TV receiver if requir

A NINE VALVE HIGH-FIDELITY RADIOGRAM CHASSIS

Nine and ten valve chassis incorporate the Mullard 5-10 AMPLIFIER CIRCUIT Frequency response 40-13,000 cycles, Max. output 10 watts.

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A NEW 10 VALVE DUAL WAVE RADIOGRAM CHASSIS

WITH BASS AND TREBLE BOOST

The ideal chassis for those difficult locations where reception is doubtful. Specifications are nine valve unit, but with the addition of high gain tuned R.F. stage giving greater sensitivity and selectivity on both broadcast and short wave bands.

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NEW SEVEN-VALVE HI-FI CHASSIS

This new compact dual wave seven-valve chassis uses the same tuner circuit as our 9-valve unit with the Mullard tone-control circuit giving separate bass and treble controls. Push-pull output using two of the new 6BM8 dual purpose output valves and heavy duty M.S.P. speaker. £31/15/- F.O.R. PACKING 10/ EXTRA.

Also available with Magnavox 12W.R. Hi-Fi speaker and Ferguson output transformer at £4/15/- extra.

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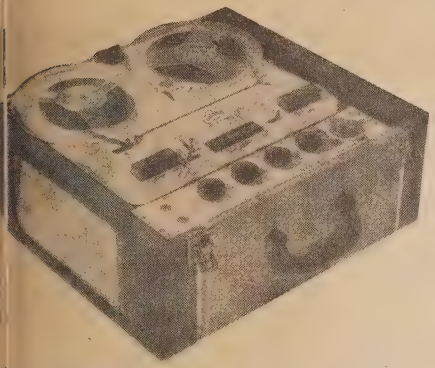

IE COMPLETE UNIT IS SUPPLIED IN TRACTIVE AND DURABLE TWO-NE PLASTIC COVERED CASE COMPLETE WITH ACOS MICROPHONE

six-valve amplifier incorporates the latest llard" tape recorder circuit equalised to C.C.R. ilards giving perfect reproduction from recorded . Record monitoring and outlet to power am-r. Extension speaker outlet and "magic eye" indicator. Amplifier is completely shielded and d with perspex dress plate to match deck.

- **HIGH FIDELITY**
  Heads are double coil wound and will reproduce up to 12,000 c.p.s. at 7½ inches per second. Azimuth adjustments on both impedance "record" and "play-back" heads. Output of heads is approximately 5 milli-volts at 1 Kc at 7½ inches per second.
- **INSTANTLY REVERSIBLE**
  Instantaneous changes can be made from one track to the other. Fast re-wind in either direction.
- **CONSTANT TAPE TENSION**
  A special Collaro device ensures a constant tension on the tape on the take-up spool as it leaves the capstan.
- **FULLY MECHANICAL**
  No solenoids are used in the construction of this Transcriptor. The braking is entirely mechanical.
- **FINISH**
  Cream Polystrene cover plate with maroon controls.
- **THREE SPEEDS**
  3¾, 7½, and 15 inches per second.
- **FOUR HEADS**
  Two "Record/Play-back" and two "Erase" heads are sited on two different levels and head wear thus halves for any given length of track.
- **TWIN TRACK OPERATION**
  One pair of heads for each track. Both top and bottom tracks can be recorded or played back without removing tape.
- **PAUSE CONTROL**
  This has the effect of stopping the transit of the tape past the "Record/Play-back" and "Erase" heads and applying the brakes to the spools while leaving all switches and mechanical functions in their selected position. Typical application is to pause whilst recording to omit speech interposed between musical selections. Control will only work whilst it is held in position.
- **TAPE MEASURING & CALIBRATING DEVICE**
  The three digit counter makes the location of any recorded passage the simplest of operations.
- **TRANSCRIPTION TECHNIQUE**
  A large diameter flywheel with ground and lapped steel shaft running on a ball at the bottom of long bearing reduces friction and virtually eliminates "wow" and flutter to less than 0.15 of 1.0 per cent.
- **TWO MOTORS**
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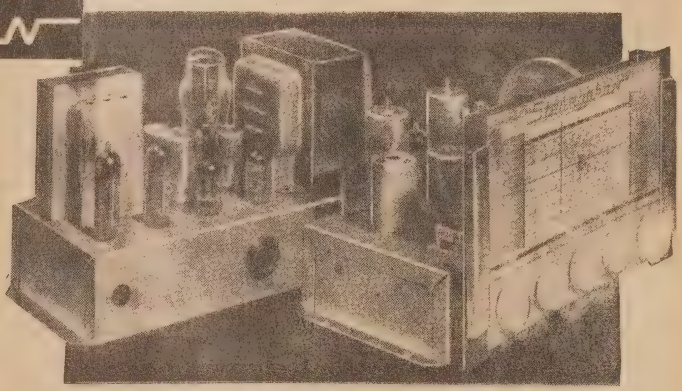

Classic Radio

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"WE HAVE EVERYTHING FOR THE HI-FI ENTHUSIAST–

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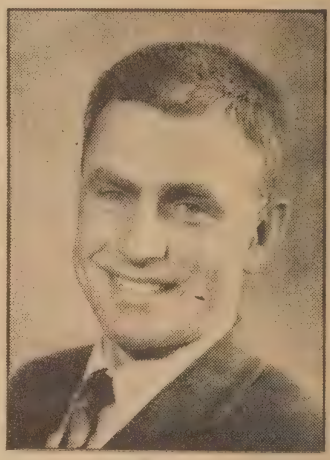

"Gordon Davies and I have been building hi-fi for years. Now we have our own modern workshop testing laboratory and auditorium. We'd be delighted to meet you and just show what you can build yourself with our hi-fi units. Drop in any time—you are not obliged to buy anything. Better still phone XJ5928 and make sure we will be there."

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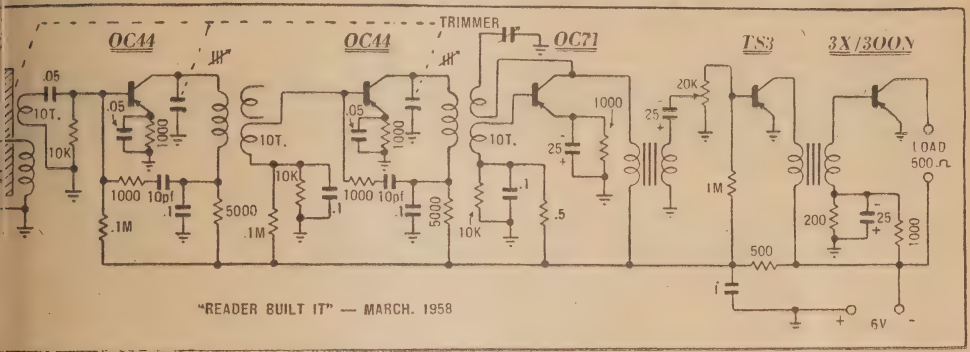
A READER BUILT IT!

Gadgets and circuits which we have not actually tried out, but published for the general interest of beginners and experimenters.

RANSISTOR T.R.F. RECEIVER HAS SIMPLE CIRCUITRY



"READER BUILT IT" — MARCH. 1958

vh transistors of certain types now being manufactured in Australia r a hope that the scarcity of imported types will be eased before long, experimenters may soon find a wide field for activity in direction. The position has not eased sufficiently for us to undertake ull-scale receiver project but this contribution by a Queensland reader may be of interest.

correspondent is Mr O. Andersen ose address is C/- Inspector of Rockhampton Qld. Readers may er that Mr Andersen submitted it which was published in the 1957 issue. He suggested then ore efficient transistors could be ted for the TS2's in the RF r stages.

rites: "The TS2 transistors, which a high operating voltage to give ble performance as RF ampli- e replaced with the more efficient types. (The OC45 seems to work well.) This change permitted a n in the operating voltage to l consequently an alteration to the of many resistors.

method of applying bias is d and where practicable it is ap- the earth end of the secondary In this way the bias resistors, arly when they are of low value, provide a shunt path to earth ne of the wanted signals as oc- hen the bias is applied direct to e lead.

OC71 is retained as a detector xed reaction making a separate unnecessary. Two efficient stages provide ample gain and sharp sel- .

audio output is particularly good ortion free.

rent drain of the set is about 30 ps. If this sounds high, it can be way of comparision, that an ord- orch bulb in common use draws approximately 300 milliamps.

"Coil details are shown in the sketch. In the case of the RF coils the added winding consists of 10 turns of about 30 gauge wire (the gauge is not critical). The additional winding on the Ferroxcube rod consists of 5 turns of 26 gauge enamel wire. Alignment of the set may be easier if an Aerial coil to match the RF coils were used instead of the Ferroxcube rod. A short aerial would then be necessary.

"The speaker transformer presents 500 ohm load impedance and is mounted on the chassis with the voice coil leads arranged so that they can drive either the 5 inch inbuilt speaker or be plugged into a large external speaker in a larger cabinet.

"The interstage audio transformers can be of practically any type designed for valve coupling and even speaker transformers, of say 500 ohm impedance can be used particularly with the voice coil winding removed and replaced with twice as many turns of finer wire.

"The three gang capacitor is of the usual type supplied to cover the broadcast range. Each section must be of the same capacitance.

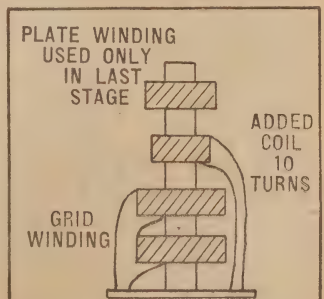
"A point of interest concerns the application of bias current through the secondaries of the audio transformers. It may be necessary to try reversing connections to get the best results. Both windings carry current which can slightly magnetise the core and affect the audio response. Best results can then depend on whether the currents through the two windings are together or opposed in direction. This can be important with the last stage as the base current of the output transistor is appreciable.

"The set is designed for 6 volt operation but will work well on 4.5 or even 3 volts.

"For those who have built the previous set, the alterations can be made without change to the layout. Two OC44 transistors, a few resistors and, if necessary, the speaker transformer will be the only additions required."

Editors Note: Mr Andersen does not mention the reason for the 1000 ohm resistor and 10 pf capacitor in series from the base of the RF transistor. Possibly these components are required for complete stability over the band. The 10 turns on the secondary winding of the RF coils seems a little on the low side and some more experiment may be worth while.

If audio transformers are used for interstage coupling between the audio stages, they should be connected in the reverse direction to that for valves i.e., with the low impedance winding feeding the base of the following transistor.



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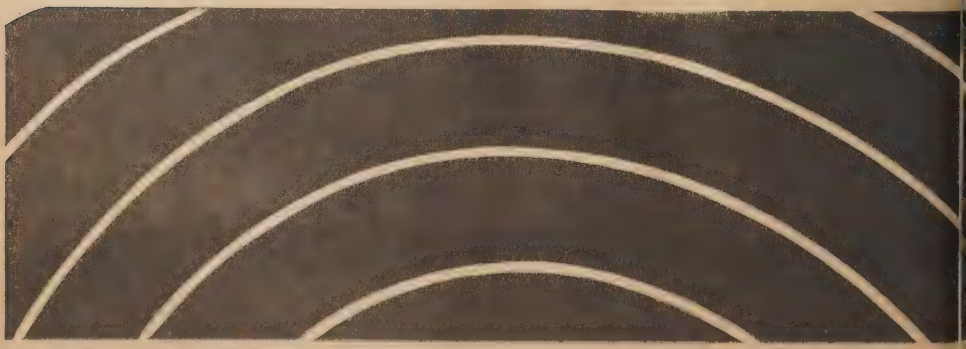

BASF

RECORDING TAPE SPECIFICATIONS

STANDARD:

Width: 0.25" plus 0-0.004"
Thickness of Base Film: 0.0015"
Thickness of Coating: 0.0005"
Tensile Strength: 8 lbs. per ¼" width
Elastic Elongation: At 1 lb. load, less than 0.5% (1 minute application)
Magnetic Properties: Coercive force approx. 300 Oersteds
Frequency Response: The BASF tape permits recording and playing back of frequency more than 15 kcs at a tape speed of 7.5"/sec. and up to 12 kcs at 3.75"/sec. with a straight frequency curve, when machines at present on the market are used.
Modulation Noise: More than 50 dB below peak modulation (measured as DC magnetization)
Basic Noise: From a tape erased in the normal manner is at least 65 dB below recording level.
Erasure: Under normal erasing conditions more than 65 dB
Print: Exceeding 60 dB after close contact for 5 minutes

LONG PLAY:

Width: 0.25" plus 0-0.004"
Thickness of Base Film: 0.0009"
Thickness of Coating: 0.0005"
Tensile Strength: 6 lbs. per ¼" width
Elastic Elongation: At 7/10 lb. load, less than 0.5 % (1 minute application)
Magnetic Properties: Coercive force approx. 300 Oersteds
Frequency Response: The BASF tape permits recording and playing back of frequency more than 15 kcs at a tape speed of 7.5"/sec. and up to 12 kcs at 3.75"/sec. with a straight frequency curve, when machines at present on the market are used.
Modulation Noise: More than 50 dB below peak modulation (measured as DC magnetization)
Basic Noise: From a tape erased in the normal manner is at least 65 dB below recording level
Erasure: Under normal erasing conditions more than 65 dB
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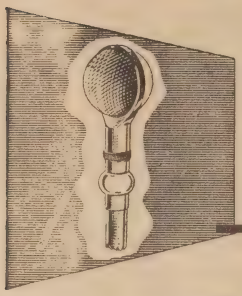
TABLE or STAND MICROPHONE, MIC22

This omni-directional Microphone is robust in construction, with a pleasing appearance. Vibration, shock or low frequency wind noise will not affect the performance. The low frequency cut-off is dependent on the load resistance. The cut-off is given by the equation, F = 80 divided by R, where F = c.p.s., R = megohms. An adaptor (floor mounting) is available at low extra cost. **PRICE, £9/18/6.**



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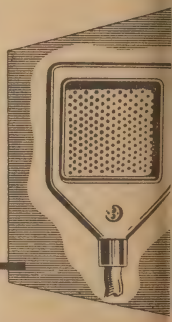
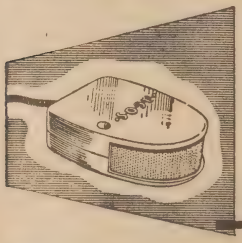


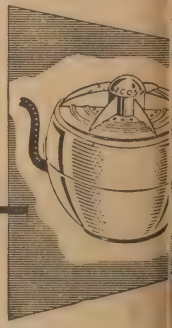
LAPEL MICROPHONE, MIC28

Designed to give freedom of movement, this Microphone is small and non-directional. Housed in a soft, moulded-rubber case, which gives protection against shock, it is provided with a pin at the rear of the case for pinning to the lape. **PRICE, £5/19/6.**



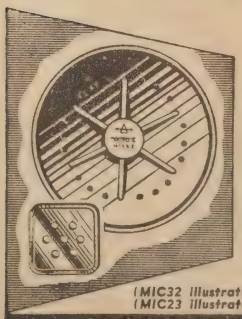
GENERAL PURPOSE, MIC35

The MIC35, is ideal for amateur transmitters, public address, etc. Housed in an attractive die-cast case, it features a high sensitivity and substantially flat characteristics. Provided with a built-in shunt resistance of 2 megohms, it will, when connected to the grid of the input valve, give a substantially flat response from 50 to 5,000 c.p.s. **PRICE, £2/15/-.**



HAND or DESK MICROPHONE, MIC33

This Microphone has been designed for the high quality public address and home recording field. High sensitivity and flat characteristics are obtained by a specially designed acoustic filter. Housed in an attractive plastic case with an unexcelled response for its size and price. Unaffected by vibration, shock or low frequency wind noise. Omni-directional frequency response substantially flat from 30 to 7,000 c.p.s. **PRICE, £6/18/6.**



CRYSTAL MICROPHONE INSERTS

These inserts are available in varying sizes, ranging from as small as ⅛ in. square to 1-⅛ in. round, with various thicknesses from 3/32 in. to ⅜ in. Suitable for every purpose, such as hearing aids, public address, tape recording, amateur transmitters, etc., they have responses from 2,250 c.p.s. to 3,500 c.p.s. at -5 db to -30 db. Insert can be supplied with or without 10 meg. resistor as required.

MIC19/4 and MIC32, **£2/15/6**; all others, **£1/19/6.**

(MIC32 illustrated)
(MIC23 illustrated)

Sole Australian Agents:

AMPLION (A'sia) PTY. LTD. 101 Pyrmont Bridge Rd. Camperd
Sydney, N.S.W. Phone LA 61

Victorian Distributors: DISTRIBUTORS CORPORATION, 403 Bourke Street, Melbourne.

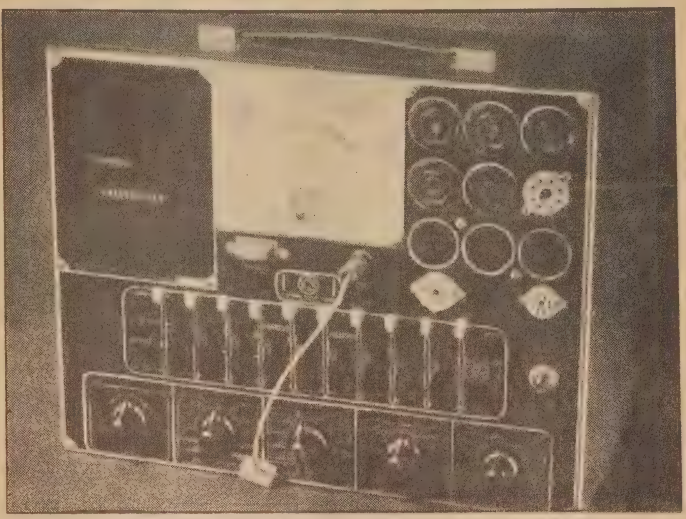
RADE REVIEWS AND RELEASES

VERSITY INSTRUMENT TESTS WIDE RANGE OF VALVES

tester model TVT from ersity Graham Instruments Ltd. tests all current radio television valves under the ard R.T.M.A. emission test conditions.

ISION is made for the introduct- f new valve and socket types ns of blank socket spaces left ont panel and this feature com- ith the completely flexible lever of selecting the filament and trode ensures that the tester will o out of date.

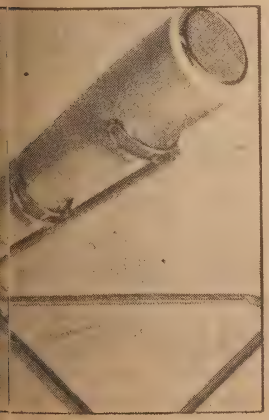
tandard TVT is priced at £40 s tax where applicable. A more e instrument under the type TST/2 basically the same as the ut including a comprehensive ter is available at £58. Both in- s are designed to take a picture aptor which is available as an £3. The latter items are plus where applicable.



.ITY CRYSTAL MIC.

cos MIC 39-1 crystal stick mic- one from Amplion (A/sia) Pty. ently tested proved to be an ex- tperformer. We were impressed smooth response and particu- ith its freedom from acoustic when used close to a loud- system. The latter, no doubt, to the lack of an appreciable in front of the sensitive ele-

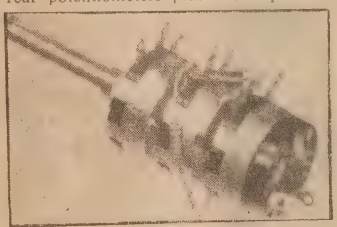
nanufacturers data gives the fre- response as virtually level to 10 e being a slight rise at about The output is -62 db taking ttlyne/squ.cm. as reference. ks well with its finish in cream d.



NEW IRC CONTROL

W. J. McLellan and Co. Pty. Ltd. have submitted a sample of a multiple potentiometer intended for use in a television receiver and combining the functions of loudness and brightness controls. The unit submitted has elements of value suitable for the R. TV. and H. 17 inch television receiver.

The loudness control uses the two rear potentiometers plus two capacitors



and a resistor and differs from the usual volume control in that both the treble and bass are progressively boosted in relation to the mid-frequencies as the volume is reduced, thereby compensating for the natural characteristics of the ear. Obviously exact compensation is impossible unless the overall gain, both electrical and acoustical, between the control and the ear is standardised. However, a reasonable approximation can be made.

The front element is a normal potentiometer used for the brightness control and is operated by a shaft concentric with the loudness control shaft. The retail price is 40/- or 46/6 for the version with the double pole switch as illustrated.

LOW FREQUENCY IF TRANSFORMERS

CONSTRUCTORS of double superhet communications receivers will welcome the Q plus IF85 85 Kc medium-gain high-selectivity IF transformers recently released by R. W. Steane and Co. Pty. Ltd.

The transformers are mounted in a 1-3/8in diam. shield can 3in high and both windings are slug tuned. Fixed 400 pF silver mica capacitors in parallel with each winding assist in maintaining high stability. Both primary and secondary windings are pie wound in litz and heavily impregnated with polystyrene.

The unloaded Q of the windings (in the can) is 55 and the manufacturers expect that a single stage (two transformers) will give a bandwidth of less than 1 Kc at 6db down.

The list price of the IF85 is 20/8.

BUILDING a RADIO?

* *Use the National buyer's guide below to select the right National Components.*

TRANSFORMERS FOR MANTEL RECEIVERS AND RADIOGRAMS

R, TV & H Kits Issue	Type	Primary	mA	A.C. H.T. Volts	Filament Ratings			Mounting
Mantel Receivers								
Little General April, 1957 3 Band Rx August, 1957	U or F30/150	230/240	30	150/150	6.3v/1.7a			Midget U c
Any standard mantel Rx	U or F40/285	"	40	285/285	6.3v/2a		5v/2a	Upright or
	U or F40/325	"	40	325/325	6.3v/2a		5v/2a	Upright or
	U or F50/225	"	50	225/225	6.3v/2a			Upright or
Radiograms								
Economy 5 Sept., 1957 Economy 5 Dec., 1957	U or F60/285	230/240	60	285/285	6.3v/2a		5v/2a	Upright or
	U or F60/325	"	60	325/325	6.3v/2a		5v/2a	Upright or
Std. Gram. May, 1957 D.W. Gram. July, 1957	U or F80/285	"	80	285/285	6.3v/2a	6.3v/2a	5v/2a	Upright or
	U or F80/325	"	80	325/325	6.3v/2a	6.3v/2a	5v/2a	Upright or

National

POWER TRANSFORMERS

FILTER CHOKES

CHOKES FOR MANTEL RECEIV AND RADIOGRAMS

Type	Inductance in Henries	mA	Ohms Resist
B14/60	14	60	52
C15/80	15	80	43
E30/80	30	80	31

The above transformers and chokes are part of National standard range and are stocked by your supplier.

Australian and Overseas Agents:

Wm. J. McLellan & C

PTY. LTD.

126 Sussex St. (Nr. King St.), Sydney. BX1131.

VICTORIAN AGENTS:
Australasian Engineering Equipment Co. Pty. Ltd.
476 Latrobe St., Melbourne. FY2638.

FACTORY REPRESENTATIVES:
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Western Australia: I. W. Holman, Perth BA8190.

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ILD-IT-YOURSELF VALVE VOLTMETER BY COSSOR

quality kitset at moderate ce enables homebuilders uire a compact valve volt- er of commercial standards. instrument measures both and DC voltages and resis- ce up to 1,000 megohms.

T of us who have followed Ame ican publications have studied en- the advertisements for kitsets of s types. We were therefore very ted to receive, for review, a kit ilar type under the well-known brand.

voltmeter kit is the first of a r produced by Cossor to be seen country and it is possible that r other instruments will be avail- efore too long.

quality of the components, in- the printed wiring board, s to be above reproach and the s have obviously gone to a great f trouble to see that every small nent is included. Most are in- lly packed 'in moisture proofed bags.

instruction manual, which goes he kit, is one of the most com- sive and excellently produced pub- is of this type we have seen. It s of 45 pages printed on quality and covers every detail of assemb- adjustment.

fly, the DC ranges of the fin- nstrument are from 1.5 to 1,500V ale with an input resistance of 11

The assembled instrument is only 9½in by 5in by 4¾in. It weighs 4½lb and consumes 10 watts approx. from the 240V 50 cps power mains.

megs. The AC ranges are similar with the input impedance ranging from 1 meg., 40 pF to 3 meg., 20 pF. The resistance range permits measurements between 0.1 ohm and 1,000 megohms.

The kit reviewed was supplied by Jacoby, Mitchell and Co. Pty. Ltd., 477 Kent Street, Sydney. The price is £29.

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A COURSE IN TELEVISIO

PART 28 — SAWTOOTH DEFLECTION OSCILLATOR

This is the first of several instalments dealing with the deflection circuits of television receiver Both line and frame deflection will be covered and, as indicated by the heading above, this pa ticular article is devoted to sawtooth oscillators.

THE general scanning requirements for a modern television receiver were explained in parts 1 and 2 of this series (September, October, 1955) and readers should refer back to these articles if revision is needed.

It is sufficient to recall here that the writing beam in a television receiver needs to be deflected in two distinct modes.

It needs to be deflected horizontally to produce the line structure, the line frequency in the Australian system being 15,625cps. This compares with 15,750 for the American system and 10,125 for the British.

FRAME DEFLECTION

Simultaneously, the writing beam needs to be deflected vertically at the frame or field rate (there is a discrepancy in usage here) which is 50cps for the Australian and British systems and 60 for the American.

All systems use simple interlace so that, locally, we see 50 picture presentations per second, each containing a nominal 312½ lines, alternatively odd and even.

In the standard scanning procedure, the lines are "written" from left to right and, at the end of each scan, the writing spot is flicked back to the left hand side of the screen to begin the next line. Simultaneously, the spot is moved progressively from top to bottom to build up one complete field, then returned rapidly to the top to commence the next field.

Electrically, this deflection involves the provision in a receiver of two oscillators, one to operate at line frequency (15,625cps) and the other to operate at the field frequency (50cps).

The oscillators must product a triangular waveform, something like figure 156(a), to ensure that the spot moves at a slower but constant speed in one direction, with a rapid return in the other. They must also be capable of locking positively to the incoming synch signals from the transmitter.

Output signals for the respective oscillators, duly synchronised, are normally fed to line and frame amplifiers stages, which deflect the electron beam in the picture tube.

In elementary small-screen receivers, electrostatic deflection is commonly used. The deflection amplifiers resemble resistance-coupled voltage amplifier stages, their role being primarily to develop high signal voltages across load resistors for application to the deflector plates in the picture tube.

It is often quite a problem to develop an adequate deflection voltage and, in addition, coupling and shunt capacitance in the circuit can readily cause sufficient loss and phase shift to prejudice the shape of the sawtooth deflection voltage.

MAGNETIC SYSTEM

For all other receivers, electromagnetic deflection is employed. In this case the deflection amplifiers resemble power stages, being designed to deliver a high signal current through an output transformer to magnetic deflection coils in the yoke.

The basic requirement is therefore a sawtooth deflection current and, due to the complex nature of the plate load, this does not automatically result from applying a sawtooth voltage to the amplifier grid.

Also, with wide-angle magnetic deflection, the screen may have a good deal less curvature than the natural arc of the scanning beam. As a result, the edges of the picture may be stretched unless the deflection current follows a law which is slightly "S" shaped rather than being perfectly linear.

Faced with such problems, a designer may suitably compensate the amplifier stage itself or he may accept or even arrange some irregularity in the output of the oscillator if he can, by such means, more easily obtain the end result.

This complicates considerabl discussion of deflection oscillato cause one thinks naturally in te pure sawtooth waveforms, only cover plenty of receivers in wh oscillator waveform is oddly shap

Probably the most helpful co initially to examine methods, wit limitations, of producing sawtoot ages. Allowance can be made afte for any departures from the ideal may be accepted or even sought, task of achieving a linear overa ture scan.

Figure 156a shows an idealise tooth waveform. The voltage bu in perfectly linear fashion from and assuming linear relati throughout the amplifier circuit, move the beam at an even rat left to right across the screen o top to bottom in the case of the circuit.

At the moment when the beam es peak deflection, the impulse instantly to zero (B to C) ready t the next writing trace.

In practice it is not poss achieve an instantaneous "retra "flyback" characteristic, since it involve infinite figures of voltag rent and frequency.

RETRACE TIME

A more practical sawtooth wav shown in figure 156b in which back portion of the wave occ finite period of time, the peaks sawtooth also being very slightly ed.

An adequate retrace period vided for in the transmission st by allowing a small time lapse the finish of one line and the the next, and between successive During this time lapse, the video is held at blanking or black le that the writing beam is black

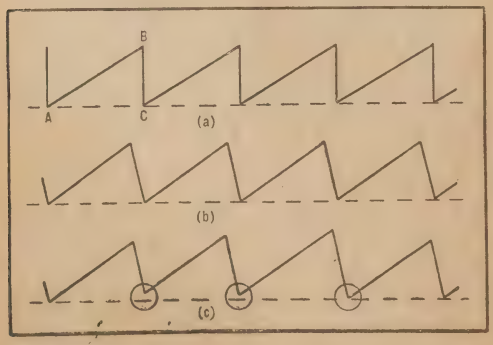
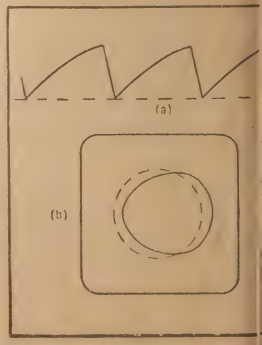


Figure 156 (left) showing (a) an idealised sawtooth waveform, (b) a more practical waveform with finite retrace time and (c) a waveform showing undesirable erratic tendencies

☆

Figure 157 (right) illustrates the likely effect of non-linearity. A circular pattern becomes egg-shaped.



being returned to its starting point. viously, the retrace period of the ators in a receiver must not be r than allowed for in the standards, ws portion of the retrace lines be visible and/or portion of the e lost.

diagrams 156a and 156b each cycle cillation is identical to those which de and follow it. Whether related ne or frame, the scanning action therefore be perfectly smooth as, ct, it should be. If any condition e oscillator should cause it to pro- output cycles varying in amplitude equency (Figure 156c), the scanning be similarly erratic, causing picture

figure 156 also, the rise in voltage he forward trace is strictly linear, ndition which is often difficult to ve in a practical circuit. Figure 157 rates the possible effect of a non- deflection voltage on a television e, if not suitably corrected.

N-LINEAR SCAN

th an oscillator waveshape as n in diagram (a), the rate of change eater than average at the start of canning cycle, falling below aver- oward the end. The beam therefore to move rapidly away from the hand edge of the screen, slowing ressively as it moves towards the

us scanned, a circular object or trn on the screen would become egg- ed, as shown.

nilarly, non-linearity in the frame ator may lead to distortion in the ral plane, while a combination of two can produce very misshapen es indeed.

early all sawtooth generators utilise dea of charging a capacitor through sistive circuit to give the forward and a rapid short-circuiting action ischarge the capacitor to produce flyback pulse.

ie action is illustrated in figure 158. voltage "E" is applied to the net- c: as in (a), the potential across cap- "C," plotted against time, rises in rdance with the curve A-B.

when the capacitor approaches mum charge, it is suddenly short- ited by a switch, the charge across ill disappear. Opening the switch n will allow the charging cycle to e peated and the net result will be n pproximate sawtooth voltage across ecapacitor, as in graph (b).

SIC FACTS

ertain interesting observations can be ne about this elementary, yet basic ngement.

the first place, the general slope f he line from A to B, or the rate f harge, is determined primarily by relative values of C and R. As r one or both are increased in val- e their so-called "time-constant" is in- sed and the charging cycle is length- n.

a frame oscillator, therefore, where forward scan time is relatively long. relevant values of R and C need nally to be much greater than in ne oscillator.

his is not the end of the story, how- v. While R and C are normally portioned to suit the role of the os- ltor, the actual sawtooth output fre- ncy is dependent as much as any g on the operation of the capacitor harge circuit.

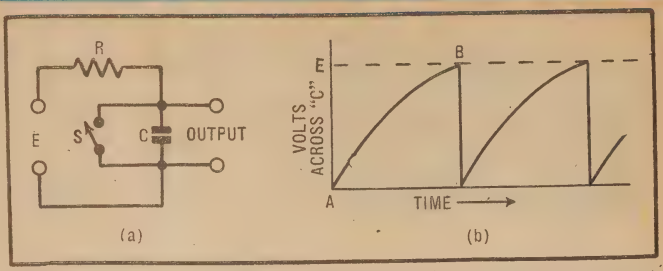


Figure 158: Diagram (a) illustrates a basic charge and discharge circuit around which most sawtooth oscillators are designed. Diagram (b) indicates the natural output waveshape. Note the curvature in the line A-B.

This may operate when the capacitor is approaching full charge or it may operate when the capacitor has received only a small percentage of full charge. In the latter case, the output frequency will be higher, although the peak-to-peak voltage swing will be lower.

It is also noteworthy that the line A-B is markedly curved and this could lead to the condition depicted in figure 157.

The reason for the curvature is not hard to find.

At the beginning of the charging cycle, the full supply voltage is across the resistor and maximum current flows through it. As the charge across the capacitor rises, the voltage across the resistor falls and so also, by Ohm's law, does the charging current through it.

LINEARISING CIRCUITS

This non-linearity is fundamental in its origin and steps are commonly taken in the design of oscillator circuits to counter it.

One obvious course is to arrange matters so that only a small portion of the total charge curve is used, for example the section of A-B adjacent to A in figure 18.

By way of example, if "E" were 400 volts and the charge and discharge cycles were allowed to run their full course, something approaching 400 volts P-P of sawtooth waveform would be available across C. However, the voltage-time relationship would be anything but linear.

If, on the other hand, the capacitor were allowed to charge to only 100 volts before being discharged, linearity would be better, though the signal available would be less than a third of the former figure.

In practice it is necessary to go even further than this and to restrict the charging cycle to about 10 per cent of the supply voltage before reasonable linearity is obtained by this method. This may involve extra amplification between the oscillator output and the deflection elements but the alternative of using a higher source voltage for the capacitor charge is seldom convenient.

Linearity can also be improved by supplementary circuit arrangements which make "E" appear to be a much higher voltage source than it really is, or which maintain a more nearly constant charging current than can the simple resistor "R". Examples of these techniques are found respectively in the Miller Integrator circuit and the Linearising pentode, to which reference will be made later.

The further idea of offsetting non-linearity in the oscillator against effects elsewhere in the circuit has already been mentioned.

It is self-evident that a mechanical switch cannot be considered as the discharge device, and its function must be performed by an electronic device or circuit which can remain "open" during the charging cycle and yet suddenly assume very low apparent resistance to discharge the capacitor on a cyclic basis.

NEON OSCILLATORS

Probably the simplest of all such devices is a neon or gaseous discharge tube. Such tubes contain two elements in an atmosphere of inert gas, and in their normal condition are virtually an open circuit.

If a voltage is applied between the two elements and gradually increased, the gas will suddenly ionise and allow conduction through the tube. As the voltage is then reduced below this "striking" potential, it will reach a much lower figure—the extinguishing voltage—at which conduction suddenly ceases and the tube once more becomes a virtual open circuit.

A workable oscillator can be made simply by replacing the switch S in figure 158 with a neon tube and maintaining the voltage E substantially above the striking potential of the tube.

At first application of the voltage to the circuit, the charge across C builds up till it reaches the striking potential of the tube, usually about 80 volts. Conduction through the tube then rapidly discharges the capacitor to the point

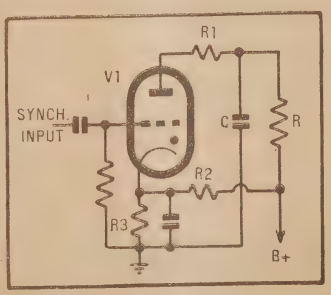


Figure 159: A simple gas-triode sawtooth oscillator, as used in many test oscilloscopes. This type of circuit is seldom used nowadays for TV receivers.

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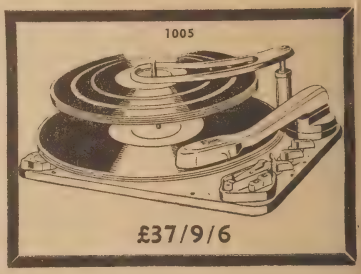

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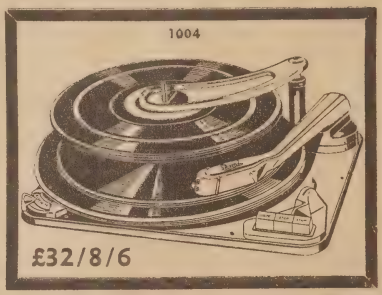

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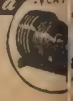

it can no longer support conduc-
he extinguishing point of the aver-
be being about 20 volts.
diately conduction ceases, the
across C begins to build up again,
cle of events repeating indefinitely.
an oscillator might therefore be
ed to produce a sawtooth wave-
having a peak-to-peak value of
60 volts and at a frequency deter-
mainly by the values allotted to
R.

o vary the operating frequency,
er value or both could be made
stable.

all its simplicity, the simple neon
tor is seldom if ever used in tele-
receivers. There are at least three
reasons for this:

There is no simple and reliable
of locking the oscillator to the in-
g station synchronising pulses.

The striking and extinguishing
tials are subject to both short-term
ong-term variation, leading to pic-
itter and drift.

There is some lag in the extinguish-
ction, and this, combined with the
natural internal impedance when
cting, may make the retrace period
ong for a satisfactory waveform
line frequency at least.

Forward-trace linearity is poor.

TRIODE

The basic principle found in the neon
ator is applied to better advantage
various gas triode and gas tetrode
s which have been developed and
ed for sawtooth oscillator service.
have now been almost completely
seded in TV receivers, but are very
non in test oscilloscopes, and are
ny of mention as a result.

Figure 159 shows the basic circuit
gas triode oscillator. (Note that
in the envelope or cross shading
only indicates a gaseous valve as
ast the normal fully evacuated
p)

The basic charge components are still
snated as R and C and the initial
n is much as described for the neon
ator. When voltage is first applied,
is no initial charge across C and
efore no initial plate voltage on the
l.

However, as in the previous instance,
itor C immediately begins to
ge, and a gradually rising plate
ge is apparent on V1. When the
ge reaches a certain critical value,
gas in the triode ionises, drops the
dance of the triode to a low figure
discharges the capacitor to a rela-
ly low voltage.

CLE REPEATS

At this point ionisation in the valve
ases, its internal resistance rises, and
charging cycle begins all over again.
esistor R1 is included in the plate
it purely to limit the peak current
ugh the valve to a safe value. Its
presence in the circuit, together
the resistance inherent in the valve,
os down the rate of discharge and
ses a minimum limit on the dur-
n of the flyback pulse.

The grid potential in a gas triode sets
voltage at which ionisation will occur.
practice, the simplest way to preset
grid potential is to return the grid
arth through a normal resistor R2
provide for additional bleed current
ugh a cathode resistor. Hence the
sion of R2 and R3.

Thus, the point of ionisation can be
set by the cathode potential, while the point of de-ionisation is determined by the valve. By suitable adjustment, the peak charge-discharge potentials can be set to any required small fraction of the supply voltage, so that linearity can be improved at the expense of peak output.

The rate of charge during the forward pulse is determined by the time constant of C and R.

The objective for TV service is so to arrange the R/C time constant and the ionisation point in the tube that natural sawtooth frequency is a trifle lower than the required output frequency.

Under these conditions, a relatively small positive pulse on the control grid will cause the valve to ionise at the "synch." impulse and the spot will fly back to the start point and begin the next cycle of operation.

Figure 160 illustrates the effect of a synch. pulse on a freely running oscillator and is worth studying, because it applies in general to all types.

The natural period of the oscillator, in this case a gas triode, is normally set to be a trifle longer and the frequency therefore a trifle lower than required, to remain in step with the line and frame scan at the transmitter.

APPROACHES CONDUCTION

Beginning the left of figure 160, the forward trace of charging cycle of the oscillator proceeds at about the correct rate and is approaching the state when natural conduction and flyback would occur when the end of the transmitted line or frame arrives.

At this instant, the transmitter radiates a pulse which is separated by circuits discussed in an earlier issue, and fed to the oscillator in appropriate amplitude and phase.

The incoming synch. pulse "triggers" the oscillator and initiates conduction and flyback at exactly the instant it is required for synchronisation. Once initiated, the oscillator passes through its natural discharge cycle and the next charge (and forward trace) commences, to be terminated again at the right instant by the next synch. pulse.

If the natural period of the oscillator is so long that it is nowhere near conduction when the synch. pulse arrives, it may not trigger. This is the reason, by the way, why a line oscillator will normally ignore the half-line pulses which occur during the frame synch. block.

Conversely, if the oscillator's natural frequency is higher than the required scan rate, it will have begun the retrace before the synch. pulse arrives. Since the synch. pulse can only initiate conduction—not retard it—an oscillator running at too high a frequency will not lock.

In a practical television receiver, two controls are normally accessible, marked "Line Hold" and "Frame Hold." These serve to vary the free-running frequency of the respective oscillators by one means or another, and the set-owner merely adjusts them till the picture locks.

What he actually does is to set the free-running frequency of the two oscillators at slightly below the standard scan rates so that the oscillators will lock readily in the presence of a signal.

Gas triodes are much more practical as sawtooth oscillators than simple gas tubes, if only because the presence of a grid provides a means of controlling their conduction cycle and injecting synch. pulses.

However, even though better than neon oscillators in regard to stability, linearity and retrace time, they are still far from ideal, especially for line oscillator service. Television receivers have used gas triodes and tetrodes in the past for frame circuits, but it is certainly not current practice.

All modern receivers use conventional fully evacuated valves, and the relevant circuits will be the subject of the next article in the series.

(To be continued.)

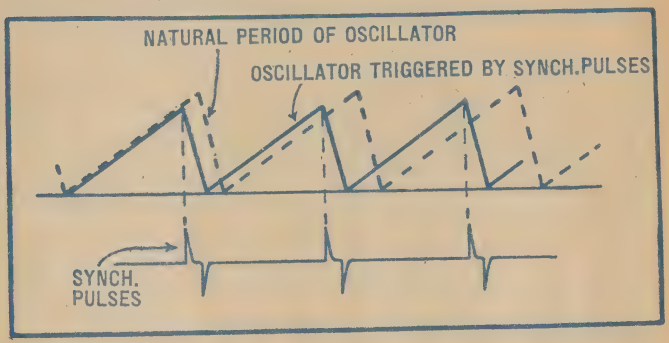

Figure 160: This diagram illustrates the manner by which synch. pulses can lock an oscillator running at slightly below optimum frequency. Note that the synch. pulses initiate the discharge or flyback function, not the forward trace.

BOOK REVIEW

ROLA PERMANENT MAGNETS. Rola Company (Aust.) Pty. Ltd., soft cover, 41 pages, 8in by 5in.

Intended for electrical and electronic engineers designing equipment using permanent magnets, this booklet summarises magnetic circuits, the magnetic and physical properties of magnets and methods of fabrication. A study of the book will assist the engineer in selecting the most efficient magnet for his purpose or alternatively to cut costs by economical design.

A list of standard Rola permanent magnets is included together with a table setting out the information required by Rola when quoting for special magnets.

The price of the booklet is 5/, post free.

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SC	DC: 0-300 uA 0-12 mA 0-300 mA	6,000 OPV 2,700 OPV	0-6/30/120 -300/600	0-6/30/120/600	0-200,000-2m 0-200megs.
SU11A	DC: 0-300 uA 0-300mA	6,000 OPV 2,700 OPV	0-6/30/120 -300/1,200	0-6/30/120/300	0-2,000 ohms 0-20,000 ohms 0-5 megs.
M70	DC: 0-30 uA 0-300 uA 0-3/30/300 mA AC: 0-1.2/12A	15,000 OPV	1.2, 6, 30, 120, 300, 600, 3,000.	0-120 mV 0-6/30/120	0-2,000 ohms 0-200,000ohms 0-21 megohms 0-200

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OFF THE RECORD — NEWS & REVIEWS

The stereo disc is still the chief subject of speculation and interest overseas, although nothi very much has been added to what we already know. No one expects any results for some ti to come, although some expect to see the first discs as early as July of this year. I think the are the optimists.

by John Moyle

And in this they are not encouraged by the record firms themselves, who are non-commital, but don't encourage us to look for anything before the end of the year.

Typical of the kind of statement being made is this from EMI which was issued to the trade in England.

That says just about all there is to be certain about, although others with their ears close to the ground will go further than this.

For instance, in Hi-Fi News, published in England, the following appears:-

"The stereo position as it can be reviewed today, reveals the following facts:

"STANDARDS—Stereo discs will be cut on the 45/45 principle in Britain, on the Continent of Europe and in the U.S.A. Thus all twin-channel discs will be playable on standard equipment, irrespective of their sources of origin.

"The adoption of the "half-thou" (.0005 tip radius) stylus point will mean that both stereo and standard (non-stereo) LP's and 7-inch 45's can be played with the same pick-up.

"The adoption of the RIAA characteristic will bring all discs into line for simplified reproduction.

"DISC TYPES: Decca have decided that their stereo discs will be processed in two forms—the 12-inch 33 r.p.m. LP microgroove, and the 7-inch 45 r.p.m. microgroove.

"EQUIPMENT: Prototype discs are being made available for pick-up manufacturers, and several firms are now at work on twin-channel pick-ups amplifiers etc.

"TIME: The first release of stereo discs is expected to be made in America in the (English) autumn of this year. It is possible that small initial releases of British stereo discs will be released about the same time.

"TAIL-PIECE: Demonstrations of Decca's Stereo discs at 45 r.p.m. and 33 r.p.m. were most impressive. Quality was superb. Stereophonic effect was remarkable to a degree that must be heard to be appreciated."

Most interesting point in all this is the definite statement that the 45/45 system has been selected. In chewing over this one last month I thought that the vertical/lateral would be picked because of its easy compatability.

However the geometry of the 45/45 system is comparatively complex, and by correct connection of the coils, it can play back lateral records also.

Factors governing the selection seem to have emerged in actual practice, important among which is the matter of turn-table rumble.

It is all very well for hi-fi followers to say that their motors don't rumble. These stereo discs will be played widely with much cheaper motors on ordinary machines, and these are n completely quiet.

The vertical component in the system is much more sensitive to than the lateral, and it has been much better to distribute any suc ble evenly on both channels.

It's probable, too, that the task moving non-linearity in the cutting on the vertical motion has been di

The point is, however, that al panies will use the same standard are giving the industry time to cords and components ready.

Then we will see a selling ca which will really make things hum

★ ★ ★

BORODIN — Polovtsian D from Prince Igor. IPPOLITOV NOV—Caucasian Sketches. Play the Philharmonic Symphony Or ra of New York conducted by D Mitropolous. Coronet KLC547.

Very good sound, more like a than an American recording. B and full tone quality are given pa attention, and both are most im for this music.

There is a great deal of solo for woodwinds, horns and lower particularly in the Sketches. Thes off very well, except for a few s the second of the latter, where the rich in sound, has a little trou hitting the exact note.

The Polovtsian Dances are without the vocal part. Again the is fine, but I don't think the orch as animated as it could be.

It plays with somewhat unne restraint; I would have liked le and more abandon.

This appears to be the same re as previously issued by Philips, and a few years ago. If so, it mus been in top class in its day, fo now it is high quality.

★ ★ ★

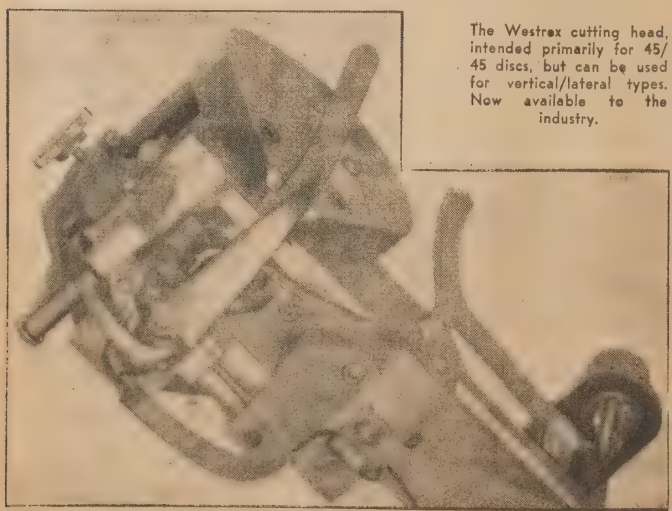
BORODIN — Polovtsian D from Prince Igor (with Chorus) RIMSKY-KORSAKOV — Le D'Or Suite. Played by the L Symphony Orchestra conducte Antal Dorati. Mercury MG5012

I am awarding this disc five not because it is perfect, but bec is so much more successful in ways than its competitors that them who manage to head it o deserve six stars.

Its Borodin isn't really a com with Coronet's fine version bec is inclusive of the vocal parts, therefore more akin to a ball formance than the concert hall.

Now I have heard several rec of vocal Polvtsians, but they ha made me wish that the singers been included.

Its quite a difficult job to n sound right, to get the balance i shape; and to avoid shrieks and odd noises.



The Westrex cutting head, intended primarily for 45/45 discs, but can be used for vertical/lateral types. Now available to the industry.

acket says these flaws have been
by placing the choir behind the
r, thus presumably balancing ur
sound as heard by the micro-
nd reducing undesirable echoes
rberation.
at as it may, the end result fully
the means. The orchestra is in
rm, and all concerned have man-
whip up that excitement and
lour which makes the thing.
e seen this ballet at the Paris
House, superlatively mounted, but
ic had no more of the authentic
an you will hear here.
Coq D'Or is extremely good if
te as sensitive and mystical as
d be. But it is so good, really
nat a better performance couldn't
his one any less beautiful.
standard of recording is first
nd at times superb. It isn't nearly
e as many American Mercurys—
was made in the Walthamstow
Hall in England—and it adds an
warmth and delicacy to he
which Mercury always achieves.
hs are crystal clean without shrill-
intrusion, and there are some
eats which will leave you in no
bout the bass end.
amend this as a fine example of
ue. You will find it a record
listening into, not only for the
but to note how well everything
d and in its place.

★ ★ ★

**KY-KORSAKOV — Cappricio
nol Opus 34; GRANADOS—
uza No 5 in E minor Opus 37;
RIER—Espana; MOSKOWSKI
nish Dances Book 1 Opus 12.
l by the London Symphony
stra conducted by Ataulfo Arg-
Decca LXTA 5333.**

ayed this disc soon after Paray's
collection reviewed elsewhere.
contrast is great.
conductor is a Spaniard, and his
pre-occupation is with the
and colour of the music.
builds it into great swirls of sheer
ent and rich sound, in which
have helped him very consider

y's attention to all the touches
ngles has no parallel here.
nta has even passed some rough-
the high volume passages to en-
nat the full vitality of the music
pre-eminent.
it is, too.
e is a wide variety here, much of
ten by non-Spaniards.
Chabrier and Rimsky-Korsakov
e main items, and I found these
top class.
kowski's graceful Dances and the
za of Granados are equally well
although quieter in mood.
ould grade this as one of the most
sful discs of Spanish music I know.

★ ★ ★

**BORODIN — Symphony No 2 in
nor; Symphony No 3 in A minor
nished). Played by the Philharm-
Orchestra conducted by Nicolai
o. HMV OCLP 1075.**

these two I have always liked the
ished the better, and wonder
er it is because Glazounov orch-
d it after Borodin's death.
s smoother, cleaner and neater al-
er than the second—an extremely
ive work.
second is put together with a
er, more earthy hand in which
typically Borodin moments and melodies shine through much that might be considered mere settings for them.

Malko's work in the Third seems better than in the Second, but neither in my opinion is as good as Ansermet's version for Decca.

Ansermet has something in his imagination which Malko has not—he is never ordinary where-as Malko is often very ordinary.

The HMV recording, too, is technically very dull.

I could add several degrees of top cut to it without noticing any difference at all in the sound.

You don't have to perform the same test with the Decca to know that such liberties would be fatal.

Sorry, but it doesn't win.

★ ★ ★

PROKOFIEFF — Lieutenant Kije; The Love for the Three Oranges. Played by the French National Symphony Orchestra conducted by Roger Desormiere. Capitol P-8149.

Lieutenant Kije is a fascinating work which grows on you with repetition.

It concerns a fictitious Russian officer who was created by the army because, by a mistake, the Csar imagined there was such a person, and no one was prepared to correct him.

The Army prepared a complete dossier on his life and career, and buried him with full honours when, alas, he "died."

The Suite is in five sections representing his Birth, Romance, Wedding, a sleigh ride section Troika, and Burial. It is a mixture of music, satire, foolery and lampoon.

BRILLIANT

Brilliantly written, and with some amazing orchestration, it is a test piece for both conductor and orchestra.

It entered the recording field with a Grand Prix disc by Westminster of the Vienna State Opera Orchestra under Scherchen.

In most ways this is still the best recording. Not only was it technically before its time, but the conductor has made much more of the score than his competitors.

Nowhere else is that amazing combination of instruments in the final chord of the first section to be heard so clearly, and that is a real test.

This new Capitol isn't at all bad. The recording is more remote than that of Scherchen, or of Boult, who made a good one recently for Decca.

Boult's effort was remarkable primarily for good sound which compares will with Scherchen's, although not so detailed.

Desormiere's characterisation is its strongest point, not as pointed as Scherchen's, but much more subtle than Boult's, which has seen the fun without the sting.

LOWER AMPLITUDE

Cutting amplitude is lower than with the other two, and the music sounds paler.

The Three Oranges compares well with any previous version. Boult's disc is a direct comparison, as the coupling is the same. It is recorded more closely than Desormiere's, with more reverberation and a higher cutting amplitude.

Capitol's recordists have allowed some tape hum to come through on this side.

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D6	600 ohms	3mV	45mV	—
D2E	200 ohms	1mV	15mV	—
D6E	600 ohms	3mV	45mV	—
D15K	15,000 ohms	10mV	150mV	100 p.f.
D50K	50,000 ohms	20mV	300mV	505 p.f

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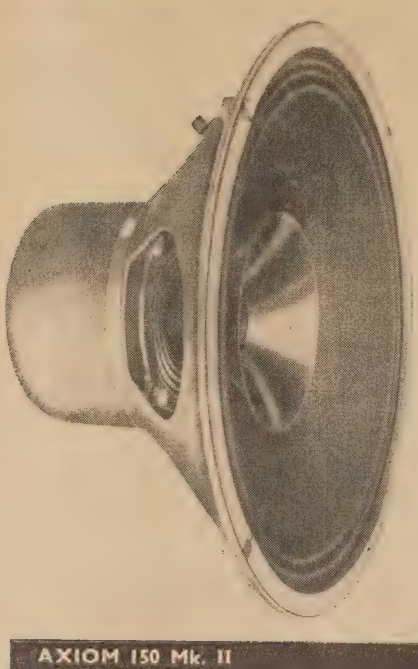

that with most manufactured articles, including Loudspeakers, a relatively small improvement in performance will raise the cost by a disproportionate figure. Therefore at some point in the price range a product will emerge which represents the best value for money. Amongst GOODMANS wide range of High Fidelity Loudspeakers this product is the AXIOM 150 Mk. II, which is outstanding for value and probably the most popular High Fidelity Loudspeaker in the world.

The full versatility of the AXIOM 150 Mk. II is described in GOODMANS new "High Fidelity Loudspeaker Manual." This publication contains details of all GOODMANS High Fidelity products. Available free on request.

AXIOM 150 Mk. II SPECIFICATION

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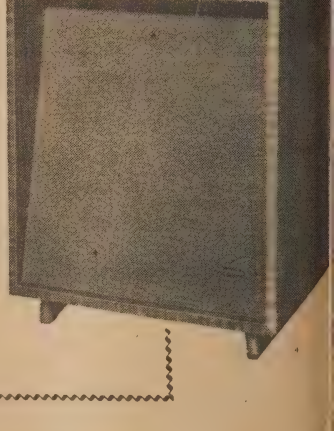

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EL — Bolero. Played by the lphia Symphony Orchestra. Con- by Eugene Ormandy. Coronet 01. (Original KLC 510).
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ODIN — Polovtsian Dances. by the New York Philharmonic ra conducted by Dimitri Mitro- Coronet KGC 103. (Original 47).
AIKOWSKY — Swan Lake Balcerpts. Played by Andre Kostelland his Orchestra. KGC 108. al KLL 521).

ie days when microgroove records oung, we were all very much up with the battle of the speeds. with the need to play records at and 33 r.p.m. we were not happy ne prospect.

ny it doesn't matter what speeds d. Every gramophone motor, from rkhorse to the aristocrat, turns at three speeds, and many of them 16 r.p.m. as a fourth.

ups, too, either have turn-over ito change the stylus size, or interable units for the same purpose. cvention has established the use of d 45 r.p.m. so that longer works e former in either 10 or 12 inch and shorter items the latter, uniy set at 7 inches diameter.

smaller diameter favours the speed, so that recording can be il nearer the centre of the discs with the 33 r.p.m. for the same of distortion.

the slower speed can be successsed with 7-inch records if the cut rea is not too great.

est techniques in restricting groove ude and depth has made it possible press the same amount of music a usefully smaller space, so that ch 33 r.p.m. is practicable within bounds if anyone cares to make

Coronet has elected to do so in a new e of discs which have just been anced.

e music comes from the more ar classic and semi-classic field, and all cases been taken from larger et discs and dubbed to the smaller. will, therefore, find similar recordson the dearer 12-inch records, to- with additional items which make e longer playing time.

Technically, the new releases appear to have been copied from the 12-inch records, and not from the original tapes. The grooving is quite close, and is constant—that is without variable pitch. Judging from inspection I would say that the depth of cut has been reduced, together with its maximum amplitude.

This is borne out by a listening comparison between the two, which reveals a considerably reduced dynamic range

Frequency response, too, is not as great. This is most apparent on "Gaite Parisienne," for instance, which was a particularly bright original.

Nor have the new versions as much output as their predecessors.

It is obvious, therefore, that hi-fi enthusiasts won't be first customers for them, but they are not intended to be.

The percentage of listeners who use ordinary commercial radiograms is very high indeed, and they will not be as aware of the difference as one might think.

On the credit side, they will be able to buy initially good performances for much less money and can play them without change of speed. Both these points were in mind when Coronet decided to issue them. It is probable, too, that the 33 speed was easier to handle in production than the 45.

The records come in attractive covers, upon which the speed is clearly marked, as it is on the discs themselves. The surfaces are generally good.

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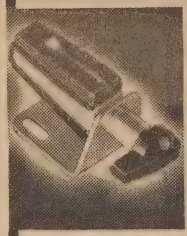

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ART—Symphony No. 25 in G K.183; Symphony No. 40 in G K.550. Played by the Philharmonia Orchestra conducted by Otto Klemperer. Columbia. 33OCX 1457.

There is little doubt that this will prove one of the most popular Mozart records of the year.

Both are two of his most important symphonies, and both Klemperer and the Philharmonia are in their best form. I do not think either is without fault.

The No. 40 I thought lacking in the first movement, which has a very special and quite rare in Mozart, but unforgivable for all that.

The work could have a touch of extra depth and feeling which Klemperer has not got, and I think the success he has with it falls short because of this.

Elsewhere it is so fine that I will forgive him for not considering my personal feelings in the matter.

Interestingly enough No. 25 seems rather more vigorous, wild and rebellious though these, to quote the jacket notes. But again, given the legitimacy of the conductor's outlook, one could not wish for better work.

The recording, too, is very fine. Its sound and balance has been most judiciously proportioned, it displays the light and shade of the orchestra with the utmost discretion; everything is smooth and clear and completely satisfying.

Truly deserves a high rating.

★ ★ ★

BEETHOVEN—Symphony No. 2 in D Major Opus 36. Played by the Leningrad Philharmonic Orchestra conducted by Alexander Sanderling. DGG LPM 18335.

Only an orchestra capable of such delicacy and brilliance as the Leningrad, could right the performance of this symphony particularly staid.

I have no doubt many people see it that way, but fundamentally it is bright and clear and can easily stand more vigour than it is given.

Alexander Sanderling takes it as though afraid that it might break if handled carelessly, or lose its dignity unless approached with reverence and awe.

Deutsche Grammophon's alternative for Columbia is a much brighter piece of work, his recording being altogether different almost throughout.

Otherwise I haven't much quarrel with what I heard, and the restrained work shows its quality equally well as the previous releases.

Columbia takes both sides to do it, whereas DGG adds the Coriolan Overture.

Columbia's recording has breadth and size and much reverberation, although not quite as clear recording. If we ignore any preference through musical values, there is a great deal to choose between them on the score of sound.

Otherwise, otherwise, your choice would entirely lie in just how you like to hear Beethoven played.

★ ★ ★

HAYDN—Symphony No. 101 in D Major (Clock); Symphony No. 102 in B Flat Major. Played by the Orchestre National de la Radiodiffusion Francaise, conducted by Igor Markevitch. Columbia 33CX1458.

I would not rate this record as being more than average.

The Clock is played so quickly and superficially that most of its charm is lost in the way.

The B Flat Major is better in this case, but nothing noteworthy seems to have been made of it.

Nor does the sound do much to help it out. I wonder whether it was made in a broadcast studio? It sounds like it.

Mostly it is weak at both ends—I would have liked more bass in particular. The net result is therefore rather middley, and extra boost doesn't do very much for what isn't there.

The standard of playing, too, is not quite first-class. A few untidy places persist in repeating themselves in a way which the best performers of today manage to avoid.

Again, it's good average.

★ ★ ★

BRAHMS—Piano Concerto No. 2 in B Major, Opus 83. Played by Adrian Aeschbacher and the Berlin Philharmonic Orchestra, conducted by Paul van Kempen. DGG LPM 18024.

I may be mistaken, but I suspect this disc was made some time ago, judging from the sound quality.

It has not the extra brightness which is characteristic of the latest DGG's.

On the contrary, it is rather dull and plummy.

It isn't a big version of Brahms. Both orchestra and pianist romanticise without achieving much stature.

Aeschbacher apparently hasn't completely made up his mind just what he intends to do about his part, for his approach seems to change from time to time as he proceeds.

In this concerto, as indeed with all works of such over-all size, one starts to build an edifice and a shape from the first note, and the outlines must not grow peaks and troughs which, no matter how intriguing in themselves, break the consistency of the whole.

It's hard to offer such criticism of a performance in which there is some otherwise extremely good work from time to time.

But that's how it sounds to me. Maybe you can prove me wrong.

★ ★ ★

STRAVINSKY—Song of the Nightingale. Symphonic Poem: Pulcinella Suite. Played by L'Orchestre de la Suisse Romande, conducted by Ernest Ansermet. Decca LXT 5233.

The Song of the Nightingale is the best side, particularly from a recording point of view.

It shows Decca in really good form, and the Swiss orchestra has always been one of its favourite vehicles for fine reproduction.

The music is an arrangement from the score of Stravinsky's opera La Rossignol, which was released a few months ago—an interesting and beautiful score which may be studied as profitably as it may be heard.

It is fairly closely recorded, but so well balanced and expertly handled that cohesion never suffers, despite the beautiful display of individual instrumental colour.

Every now and then you will hear strings, brass, woodwind and so on touched with a rare mixture of proportioned realism. I remember particularly some 'cello passages which were unusually good.

The Pulcinella Suite is based on musical excerpts from the work of Pergolesi, arranged for a ballet. Stravinsky has kept the original quality of this music, although his own hand is clearly evident—a strange contrast with the reverse side, in which his Petrouchka days are almost amusingly evident.

The recording here is again of a high standard.

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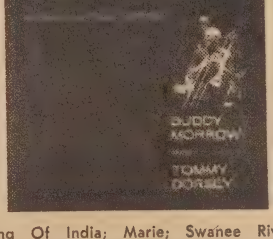

Song Of India; Marie; Swanee River; Sleepy Lagoon; Everything Happens To Me; Easy Does It; Boogie Woogie; Yes Indeed; Opus 1; Violets For Your Furs; For You; I'm Getting Sentimental Over You.

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R — Nursery Suite, Overture South" Opus 50. Played by the Philharmonic Orchestra con- by Sir Adrian Boult. HMV 359.

Nursery Suite was Elgar's last l work, and those who know y through Pomp and Circum- nd a thundering symphony will recognise its authorship.

Yet to the ears of those who ow Elgar the touch is quite un- le.

here was in Elgar, as Burnett ts it, a strain of wistful poetry, sh humour, a thoughtful and charm that too often escapes

n his most massive moods, after xhausted for the moment every us humour, you will find echoes things and they can be quite iding if you treat them as they

ally enough there is no thunder seven sketches, but there is del- ibtlety, tunefulness and a touch ning as it is beautiful.

ave to accept Elgar's personal- e you can fully accept his music f it—just as you must come to ith Schubert and Mahler and thers. To those apt to dismiss ogise for Elgar maybe this per- e will show what they have mis- was individual, and it is almost le to remain neutral about his

nan who called him a sentiment- battle-axe spoke only a half-truth. ie South is a descriptive Over- unusual length written during a t Italy, and it is as broad and as the Nursery Suite is slight. t its flavour is greatly different e British nobilmente.

st praise very highly both re- n and performances. Adrian Boult from the same school as Elgar, the same years, and understands al flavour. You may never hear isic played with a truer touch. sure I will come back to this many times.

* * *

ETHOVEN—Symphony No. 9 in inor, Opus 125 (Choral). Played e Pro Musica Symphony Orch- of Vienna with the Singverein rGesellschaft der Musikfreunde ructed by Jascha Horenstein. C. APL-10,000.

h Ninth is a very long symphony to compressed into the confines of a le disc, and this is the first one I yet received which makes the m.

h compression is almost completely ult of cutting the discs with the s as close together as possible, turally quiet passages, which re- e he least lateral movement of the ir stylus, need less "land" or sepa- between them.

nspection of this disc under a mag- ir glass will show that the spacing en reduced to the irreduceable

ley of the grooves seem to have no : at all left between them.

h danger with close spacing is that rmation of the tiny ridges between ooves will take place during the cutting process, so that a faint echo of the music contained in one groove will spill over into the next.

This was a fault which plagued early L.P.s, largely before refinements such as the heated stylus came into vogue. It still represents the chief limitation in determining how closely grooves can be cut in the original lacquer.

It is highly probable that some echo effect of this kind takes place here, although only in one spot at the end of the first movement is it audible, where a loud chord is followed by silence.

That it can be heard at all suggests that it is present in many heavily recorded sections, which may be why they do not sound quite as clean as they do on some other versions.

But results are not therefore unsatisfactory. Bearing in mind the other advantages of the single disc, I would class this criticism as comparatively minor.

In the last movement the average groove spacing is much wider than elsewhere.

The dynamic range is less than that of the best competitor, but it's by no means small.

The performance in many ways is admirable. Only in the third movement was I disappointed.

Here the balance of instruments is often uneven, minor parts are accentuated too much to preserve the even flow, and emotionally it is not deep.

On the other hand, the scherzo and the critical last movement are very good.

Sections of the choral work are almost impossible to record well, notably the high soprano notes. The danger spots on this record are as well done as anywhere.

The soloists are also good, although they don't blend as well as those on Karajan's version, for instance.

Nor is the orchestra as good.

We must remember, however, that no Ninth yet released has been free from faults, some serious, and on the whole there is nothing on this disc which can

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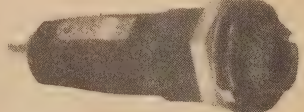

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Under these conditions, the splitting of the Adagio seems to be inevitable.

★ ★ ★

MUSIC OF LEROY ANDERSON — Played by the Eastman-Rochester Pops Orchestra conducted by Frederick Fennel. Mercury MG50130.

I first heard the Irish Suite on an American Decca recording issued here by Festival, and liked it immensely.

Leroy Anderson is an individual and accomplished arranger of light music and did much of his best work with the Boston Pops Orchestra under Arthur Fiedler.

This suite is a good example of what he can do with mood and colour.

There is nothing unexpected or outlandish about it, no exploitation of unusual modes or harmonies.

On the contrary, it is basically its good, old fashioned tunefulness which gets you in.

Its novelties, such as the Sandpaper Ballet, are cute, but fundamentally they are as straight as they can be.

The Festival disc was more forward than this one, and its general treatment more spectacular, but there isn't much to it.

I can find little fault with Mercury's weight, dynamic range, or realism.

Whether playing sweet and soft, or concentrating on blare and brass, it all comes out at demonstration standard. Played full bore it sounds fine.

The quality of the bass drums is particularly good.

Nice work, Mercury

★ ★ ★

MOZART ARIAS — Don Giovanni: "Madamina", "Mentre ti lascio o figlia"; Il Seraglio: Osmin's Aria; Magic Flute; "Qi Sdegno non s'accende": Figaro: "S vuol ballare". "Aprite un po Quegl' occhi". Sung by Ezio Pinza with the Metropolitan Orchestra conducted by Bruno Walter. Coronet KLC 651.

Before the first selection is 30 seconds gone you will have heard the best and the worst of this record.

It would be idle to suggest that age has not affected Pinza's voice, but it is in far better shape than that of other famous people who have recorded in later days.

He was always a good Mozart singer, and a great deal of his gusto and vitality is heard unimpaired. So is his control and flexibility.

Many fine notes have a rough and husky edge, but the essential timbre is there, and a good deal of the power, aided, no doubt, by rather close mike placing.

Not the least important point in building quality into this disc is the sure intonation which is as good as ever.

Similar records issued recently by other singers past their prime have been quite tragic.

There is nothing of this feeling about Pinza, although it is natural to wish that he could have made the record 10 years ago.

As it is we have the testimony of good singing—best in the Magic Flute and Figaro—and a valuable memento of a fine artist.

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5R4GY	15	0	6SK7GT	10	0
5Z3	10	0	6SL7GT	10	0
6AK5	15	0	6SN7GT		
6AG5	8	6	6SS7	10	0
6AL5	10	0	12A6	10	0
6AM5	10	0	12C8	10	0
6AN5	10	0	12SG7	10	0
6AQ5	10	0	12SK7	10	0
6AS6	10	0	12SL7	10	0
6ASTG	40	0	12SN7	10	0
6AU6	10	0	12SQ7	10	0
6BL7GT	10	0	VR105 30	12	6
6G6G	10	0	VR150-30	12	6
6J6	15	0	9003	12	6
6L6G			3BF1 and		
6M5			Socket	60	0

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SHORT-WAVE NOTES BY ART CUSHEN

MOZAMBIQUE ADDS A NEW FREQUENCY

Recently the reception of a further Lurenco Marques station has been heard in the 90 metre band, and this has been identified as CR7AA.

THE new additional frequency has been verified by Cyril Anderson, of Mt Hawthorne, W.A., and the callsign of CR7AA on 3301 Kc.

This station opens at 5.50 a.m., and carries the same English program as CR7BU on 4920 Kc. and CR7BM on 3242 Kc. The latter at times has a different program. The Portuguese language programs are carried on 3265 Kc and this station operates in conjunction with 4842 Kc. station CR7BV. The 3265 Kc station appears to be a new frequency for Lourenco Marques on this band.

English language broadcasts from the Radio Club of Mozambique take place daily, 1.30 to 7.0 a.m., and on Sunday to 8.0 a.m., and the Portuguese network 1.45 to 6.15 a.m.

ZYJ7 on 5985 Kc.

A NEW Brazilian has been noted on 5985 Kc, opening at 7 p.m. This station, formerly listed to commence transmission on 5975 Kc, has been heard opening with a Sousa march at that time. The station uses the slogan Radio Guarujá, and broadcasts from Rua Joao Pinto 42, Florianopolis, Santa Catarina, Brazil.

The station on opening with the march tune plays a typical Brazilian musical number. The transmission is commenced with a news broadcast in Portuguese. The signals are strong at this location—one of the best 49 metre signals at this hour from South America

CXA2 Montevideo

A NEW Uruguayan station, CXA2, has been heard on 6000 Kc, opening at 7 p.m., with a well-known Sousa march. The station uses the slogan, "Radio Nacional Comp. Urug de Publicidad, Yi 1383, Montevideo." After sign-on, the station broadcasts a light musical program, and normally fades out after 7.30 p.m. Strength is only fair, and interference from the stations on frequencies at the other side may prove troublesome, but listening over a period of a few evenings will enable a report of sufficient details to be compiled.

Hilversum on 25610 Kc.

RADIO Netherlands at Hilversum are now using a new 50 Kw transmitter to Australia and New Zealand on the 11 metre band frequency of 25610 Kc. On weekdays, the station operates in English from 7.0 to 7.40 p.m., and then in Dutch from 7.45 to 9.45 a.m., and on Sundays, 6.30 to 8.23 p.m. in Dutch, and in English with the Happy station program from 8.30 p.m. to 10.0 p.m. The broadcast is also carried on 21480 and 17775 Kc.

Taiwan excellent

STRONG signals are now being received from The Voice of Free China in Taipeh, in the new transmission to Japan and Korea, from 8.5 to 9.20 p.m daily. The period from sign-on to 8.30 p.m. is in English. Then follows 30 minutes in Japanese, and the remaining 20 minutes is in Korean.

Best signal is on BED7 7130 Kc. BED6 9575 Kc is fair, with side interference. BED5 on 11815 Kc has interference from Melbourne on 11810, and Peking on 11820 Kc, while the other transmitter, although free from interference, is somewhat weaker on 15345 Kc.

Kevin Dunham, of Narrandera, N.S.W., reports very good strength on two of the transmitters at his location, and expresses pleasure at the reception of such good signals from Taipeh.

ONE of our readers, Mr. John E. Dixon, 6724 Bothwell Road, Reseda, California, U.S.A., is a keen short-wave listener, and would like to hear from readers of this page. A letter to Mr. Dixon will be the start of interesting correspondence on shortwave stations he is hearing.

NOTES should be sent to Arthur Cushen, 212 Earn Street, Invercargill, N.Z. All times are Eastern Australian.

BAGDAD, which we have reported as using 7180 Kc to after 6.30 a.m., at which time it carries a program of Western music, has been heard in the United States on the additional frequency of 7065 Kc, at weaker strength at 1 a.m.

CUBAN transmitter COBL in Havana, which operates on 9833 Kc, has been heard with a session of news in English at 11 p.m.

This is a new departure for the station. The session was heard on Saturday, but reception of the signal has not been heard here daily, to ascertain if this is a feature each day from the Havana station.

PANAMA station, HOLA Emisora Atlantico, at Colon, has been noted at 2.45 p.m. on 9505 Kc, with its 250 watts of power, the broadcast being in English and Spanish.

HELSINKI, which was thought last month to have moved from 17800 to 17940 Kc, has been identified on the latter frequency, when heard at 9.0 p.m. on the first Tuesday of each month with the DX Session. The program has been noted on this occasion at both 9.30 p.m., and 11.30 p.m., on 17940 Kc, and also on the 19 metre band channel, 15190 Kc.

THE A.B.C. AUSTRALIAN S.W. SERVICES

The transmissions from the Australian Broadcasting Commission stations at Sydney, Melbourne, Brisbane, Perth and Port Moresby, are beamed to listeners in outlying areas, and relay the National programs. The complete schedule of these stations was recently released by Radio Australia, and is as follows:—

MELBOURNE:
VLG15 15210Kc, Mon.-Sat., 6-8 a.m.; Sunday, 6.30-8 a.m.
VLH11 11880Kc, Mon.-Fri., 6-9.15 a.m.; Saturday, 6-8.45 a.m.; Sun., 6.50-9.15 a.m.
VLH15, 15230Kc, Mon.-Fri., 9.30 a.m.-6.15 p.m.; Sat., 9 a.m.-6.15 p.m.; Sun., 9.30 a.m.-6.15 p.m.
VLH9, 9680Kc, Sun-Fri, 6.30-11.30 p.m.; Sat., 6.30 p.m.-midnight.
VLR6, 6150Kc, Mon.-Fri., 6-8.15 a.m.; Sat., 6-8.30 a.m.; Sun., 6.30-8.15 a.m.; Sunday to Saturday, 6.30 p.m. to 11.00 p.m.
VLR9, 9680Kc, Sunday-Friday, 8.30 a.m.-6.30 p.m. and Saturday, 8.45 a.m.-6.30 p.m.

SYDNEY:
VL16, 6090Kc, Monday to Friday, 6.00 a.m.-11.30 p.m.; Saturday, 6 a.m.-midnight; Sunday, 6.30-11.30 p.m.

BRISBANE:
VLQ9, 9660Kc, Monday-Friday, 6.00 a.m.-11.30 p.m.; Saturday, 6 a.m.-midnight; Sunday, 6.30 a.m.-11.30 p.m.
VLM4, 4920Kc, Monday-Friday, 6 a.m.-11.30 p.m.; Saturday, 6 a.m.-midnight; Sunday, 6.30 a.m.-11.30 p.m.

PORT MORESBY:
VLT6, 6130Kc, Monday-Friday, 6.45 a.m.-2.45 p.m., 4.00 p.m.-10.45 p.m.; Saturday, 6.45 a.m.-9.30 a.m., noon-11 p.m.; Sunday, 7.45 a.m.-2 p.m., 4 p.m.-10 p.m.

PERTH:
VLW9, 9610Kc, Monday to Friday, 8.00-10.45 a.m., 8.20 p.m.-1.30 a.m.; Saturday, 8.00-10.00 a.m. and 8.20 p.m.-2 a.m.; Sunday, 8.30 a.m.-10 a.m., 7.30 p.m.-1.30 a.m.
VLW11, 11840Kc, Monday-Friday, 10.15 a.m.-8.5 p.m.; Saturday, 10.15 a.m.-8.00 p.m., and Sunday, 10.15 a.m.-7.15 p.m.
VLX4, 4897Kc, Monday-Saturday, 8.00-10.00 a.m.; Sunday, 8.30 a.m.-10.00 a.m.
VLX9, 9610Kc, 10.15 a.m.-8.05 p.m.; Saturday, 10.15 a.m.-8.00 p.m., and Sunday, 10.15 a.m.-7.15 p.m.
VLX6, 6140Kc, Monday-Friday, 8.20 p.m.-1.30 a.m.; Saturday, 8.15 p.m.-2 a.m.; Sunday, 7.30 p.m.-1.30 a.m.

FLASHES FRO EVERYWHERE

SOUTH AFRICAN signals for the Tests were in the news recently, and have been on the watch for the which are carrying this broadcast for lis Australia. The best frequency was u Kc, which opens at 8.30 p.m., with th transmission and reception has been wards the end of the transmission at

CYPRUS station of the Royal Army Corps has been heard in Europe on 7 from 2.0 and 6.0 a.m. The station a the frequency as 7120 Kc, but has be as low as 7080 Kc. The last hour of t mission is devoted to requests from the in Cyprus.

SPANISH GUINEA station, Radio Bata, operates 9 p.m. to 11.45 p.m., and 8.0 a.m., with a power of 400 watts, o quency of 7850 Kc.

RADIO GOA—The arrival of one watt and two 25.000 watt transmitters transmitting site of Radio Goa in Po India, will mean that shortly this station received at stronger and clearer signals. ing to Mr. Director of Commercial of Radio Goa, Reho's House, Rua 31 de Goa, the arrival and the installation of th has been held up for a few months, bec generators and some other essential mate ered by the station have not arrived. The hopes that the new power will be in use and after this a complete new schedule put into operation.

When the new transmitters are installed no doubt improve the reception in India tan, Far East and Middle East, and the will be increased to serve these additions The station at present is broadcasting th mercial Service in English from 4.30 p.m. a.m., and news is presented at 5.30 p.m. out the week. The station at the moment received on the 9610 Kc channel.

FRENCH SUDAN transmitter, Radio P.O. Box 171, Bamako, now uses 9745 a Kc, both with 4Kw. The station is on from 4.30 p.m. to 11.15 p.m. and 5.0 to 7.30 a.m., while on Sunday and the sign-off is at 8.0 a.m. United Arabic R UAR, or as formerly known, Egypt, h heard with a frequency change to Europe. station now operates on 11995 Kc, from in French, German at 6.0 a.m., and from 7.0 to 8.0 a.m., in broadcasts fron

ANGOLA station, Radio Benguela, con ception of the CR6RF transmissions on 5 9503 Kc. Verification letter was in Engl attributed delay in confirming reception to office reorganisation.

MANILA, which recently has adde new six months, is now reported from Ja operating a station of the Government tion. The transmitter is using 4945 Kc, callsign is DZP6. The station has bee from 7.30 to 9 p.m., with programs in and Tagalog. To date our efforts to h station have not been successful, but dur ter the signals should be heard. A Philippine station, NCDA2, which is ope the National Civil Defence Administration casts from Iloilo City on 6015 Kc. Th is on the air from 8 p.m. to midnight.

GUAYAMALEN station, TGX10 has m frequency to 6050 Kc, and has increased 10 Kw. A report from Denmark states th has joined the XEWW network, and re programs of that station to 4 p.m.

DELHI, when using 11805 Kc, has be opening at 10.25 p.m., opening the regi vice. The station was heard with a preview for the first five minutes, and p.m., a program of news in English is

SUDAN, from the Sudan Broadcasting in Khartoum, is operating 3.0 to 3.15, and 6.30 a.m., and using the frequencies of 4970 and 6200 Kcs. The stations are als air on Friday, 3-7 p.m., and 12.30-6.30 Saturday, and also on Sunday, 5.30-7.30 1.30 to 6.30 a.m. on Monday. The powe shortwave transmitters is 750 watts, on 500 watts on 6200 Kc.

INDIA transmits special reports on t ings of the observations for the Inte Geophysical Year, and these are transmit Delhi. The information includes the count, which is vital to shortwave recepti broadcasts are at 11 a.m. on 9850, 1 17840 Kc, at 10 p.m. on 7130, 9850, 1 17840 Kc, and at 3.45 a.m. on 4960, 71 Kc.

MADRID, in its transmissions t America, has been noted with two cha the 31 metre band, and is on 9363 Kc, when the service opens at 9.30 a.m North American service is best ed at 3.15 p.m., and now uses the fr of 9363, 7100 and 6130 Kc, in the 31, 49 metre band in the service of the Spa tional Radio.

HE HAM BANDS WITH BILL MOORE

firing of the American satellite into space in January saw many amateur stations fully ipped to receive the report on the moon's 108 Mc/s transmission. In newspapers through- the Commonwealth amateurs were quoted concerning details of the signals, and initial reports were utilised to assist in plotting the satellite's orbits.

months of planning and work had been ded on the project to receive the signals. in as executed in N.S.W. provided for information on the moon's appearance ydney so the watchers could adjust their to sight the satellite in orbit.

Stitt, VK2WH, of Forbes, and Neville K2DR, of Blayney, supplied this infor- planned by amateur link to John Miller, of Sydney, who in turn passed it to y Amateur Astronomers' station at Bel- Bob Godsall, VK2ARG, and VK2ANF coupled with 108 Mc/s convertors. All eard both transmissions from the satel- e first signals recorded in N.S.W. were /H's QTH at 0555 hrs EAST, Sunday,

tion was also supplied to official Federal G4WIA for transmission to IGY authori- delaide.

the initial information supplied to the ching station was used to plot the orbit tellite. It was not until 12 days later, moon was overhead during night hours, advance information was used to line ypes.

received by amateurs were broadcast mber of commercial stations.

c station presented a session on the work in this field, including a complete 7 Mc/s concerning the moon's progress. aximum strength Alpha's signal was the of those from Sputnik I and II. Ama- erally received valuable publicity from icipation in this phase of the I.G. Year.

N.S.W. ANNUAL CONVENTION

ghth annual convention of the N.S.W. on was, as usual, held over the Aus- y holiday weekend, a busy period for with the convention, the national field BERU contest.

nvention commenced with the normal meeting held at Science House when Stevenson, of S.T.C., lectured on tran- d their use by amateurs. The lecture by slides covered all phases of tran- ration.

cturer pointed out that the transistors in the country were not generally suit- RF working but these types would be shortly. These available, however, could in a multitude of positions in amateur equipment, especially for mobile/portable work- ing.

Present at the meeting was Max Hull, VK3ZS, Federal vice-president of the W.I.A., who had travelled to Sydney to attend the convention. Max spoke at length on the activity and work of the Federal executive.

He outlined the executive's program and pro- posals on the subject of direct amateur repre- sentation at the next ITU convention to be held at Geneva in 1959.

Amateurs throughout the country will be re- quested to assist in the financing of the delegates' trip and expenses while in Geneva. All Australian amateurs will receive a letter from FE covering the proposal. It will be necessary to raise ap- proximately £1,500 to meet the expenses to be incurred.

Max again explained the proposal to N.S.W. amateurs over the VK2WI Sunday morning broad- cast.

The main session of the convention was held during Saturday afternoon and evening at the VK2WI transmitting site at Dural.

RECORD ATTENDANCE

There was a record attendance present. More than 200 persons and their families with 139 licensed amateurs registering. The follow- ing call signs were listed, VK3ZS, VK1ZCA, VK2s, APQ, ALJ, ARG, OT, EO, DO, ZDM, ZJC, AHX, OI, FY, EW, AGF, AIZ, AJS, PM, ER, DR, BD, CB, XT, EP, ZI, BQ, YM, EI, XX, HL, ZDE, UO, RI, ZDI, QL, ZAF, AAJ, AUM, ON, JU, ARR, ZBX, ZCW, PF, AJA, RU, ZAL, ND, TQ, AIS, ZAC, ZMN, CD, VN, IK, AJW, TP, ZCF, IC, ADF, XZ, AUA, HU, AWZ, EL, QZ, AVJ, AWW, AVQ, HZ, BP, MZ, EX, OA, MP, OZ, AKV, ANF, AET, JW, VY, AYE, WJ, AOQ, AVW, ACP, AGH, AVK, AOU, ARZ, ART, ATO, AZO, QX, ZF, AAP, ZAU, ABU, AIZ, ZDC, ARE, ATB, ZAB, VL, AJO, AT, ASZ, YB, AVT, ABT, FJ, ABZ, WH, BG, QS, OA, AWQ, AAB, BZ, AEZ, AB, NK, ACO, IN, ASW, ABE, BM, YR and AGY.

The session was officially opened at 3 p.m. by the State president Pierce Healy, VK2APQ, who introduced the State councillors and the Federal vice-president.

Several short lectures followed and the re- mainder of the afternoon was spent on disposals equipment sale, inspection of the VK2WI instal- lation and the newly acquired 25 Kva power unit and afternoon tea.

After a buffet tea the evening section com- menced with a technical queries service.

Prizewinners of the various competitions were as follows.—Best piece of home constructed equip- ment, country, Max Pfeffer, VK2MP, of Windsor.

Max displayed a complete HF transmitter built from pieces found in boxes around the shack.

The city prize was won by Max Riley, VK2ARZ, for a beautifully constructed panoramic adaptor.

The conducting of an event of this size neces- sitates a tremendous amount of organisation by council members and others. Many contributed to the success of the event. Among them were secretary Norm Beard, VK2ALJ, Bob Godsall, VK2ARG, vice-president, and VK2WI engineer Dave Duff, VK2EO, prominent in many fields.

George Rutter, VK2CB, was responsible for much of the work on the VK2CM console, while Mrs Duff draped the VK2WI studio. Registration was in the capable hands of John Mackey, VK2ZJF, Laurie Cartwright and John Lek. Wal Webster, VK2EW, arranged the lecture and Brian Jones, VK2AVJ, and Roland Greyas the seating.

Disposal equipment was distributed by Alex Dan, VK2AUU, Harry Solomons, VK2AIZ, and Ted Howard, VK2XX.

Reg Brooks, from Gosford, with the VK2RU transistorised hailer, acted as MC.

Many others worked, too, to ensure the suc- cess of the day.

VHF RECORD

A further record in the realms of amateur VHF communication in Australia was established on Saturday, January 18.

Allan Hennesey, VK2ZAL, of Bexley, Sydney, contacting Hughie Lloyd, VK5BC, on the 144 Mc/s band, the distance covered 675 miles.

It was the longest distance contact on that band since the VK5-VK6 and VK2-ZL QSOs of 1951.

The exchange lasted for 20 minutes from 1400 to 1420 hours EAST, and was considered due to sporadic "E" reflections.

The signal followed a typical S-"E" pattern The 50 Mc band was wide open for interstate working at the time. Allan used 40 watts output with five over five array, and VHF enthusiasts were pleased to see him record the contact. He has been an ardent VHF worker since first being licensed.

The fox hunt in January of the N.S.W. VHF section was won by Bob Winch, VK2OA with six points. VK2ZAV and VK2ZBB tied for second with four points.

Third place was also tied between VK2PM and VK2AWZ three points. John Miller, VK2ANF, acted as the fox.

LOCAL NEWS

WICEN country area officers have been ap- pointed in N.S.W. The following amateurs will be responsible for co-ordinating net work in their district:—Area 1.—North Coast, Noel Hanson, VK2AHH; Area 2.—North-west, Jack Hill, VK2ADT; Area 3.— West, Hugh Stitt, VK2WH; Area 4.—South Coast and Southern, Col Fletcher, VK2ASF; Area 5.— South-west, Jim Edge, VK2IO.

Many mobile marine stations operating on the 21 Mc/s band are now identifying their ap- proximate position during QSOs—a useful innova- tion saving a deal of time and sometimes energy in beam swinging.

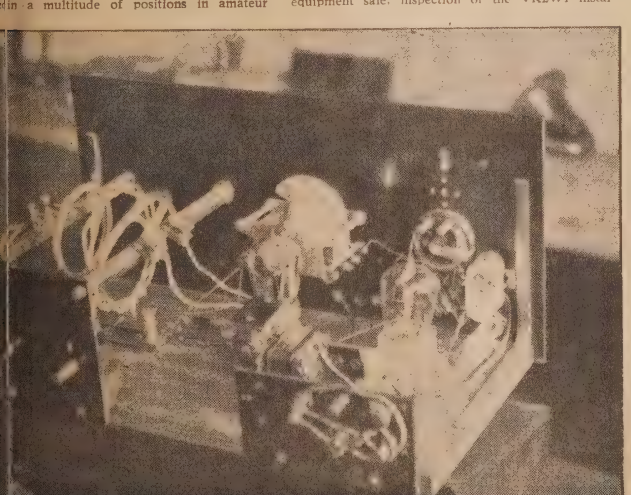
Due to pressure of business, Keith Woodward, VK2ZAU, retired recently from the position of secretary of the N.S.W. division. His successor is Norm Beard, VK2ALJ. Amateurs will wish Norm well in his new office—an arduous one in any division.

The Central Coast (N.S.W.) Radio Club com- menced AOCP class on January 27. Club mem- bership has now reached the 48 mark.

Many amateurs have already given donations to- ward the cost of the ITU delegates' expenses. Response to date has been excellent. Most amateurs appreciate the necessity to taking positive action to present the strongest possible case for the retention of current amateur bands.

The North Coast Zone of the N.S.W. division will hold its usual annual convention at Urunga over the Easter weekend, April 4, 5, 6 and 7.

General inquiries should be directed to zone officer Noel Hanson, VK2AHH, and requests for accommodation to VK2ZDO, Box 8, Bellingen.



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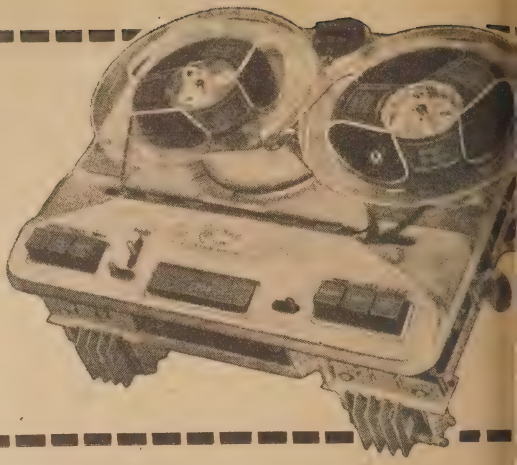

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- **TWIN TRACK OPERATION**
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- **SWITCH MECHANISM**
  Separate banks of switches are used for each track and are ready for wiring to pre-amplifier and recording heads.

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- **TAPE MEASURING AND CALIBRATING DEVICE**
  This simple **but exclusive Collaro feature** determines the exact position of a recording on the tape.

- **TRANSCRIPTION TECHNIQUE**
  A large diameter flywheel with ground and lapped steel shaft running on a ball at the bottom of a long bearing, reduces friction and virtually eliminates "wow" and flutter.

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  Each dynamically balanced motor does only one job
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  input with consequent reduction in heat and wear

- **HIGH FIDELITY**
  Heads are double coil wound and will reproduce up
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  high impedance "record" and "play-back" heads.
  heads is approximately 5 milli-volts at 1 Kc at
  per second.

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  Instantaneous changes can be made from one track to
  Fast re-wind in either direction.

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  The drive on both capstan and spool is disengaged
  machine is switched off — thus eliminating flats on
  pulleys and contributing towards elimination o
  flutter and rumble. **The "wow" and flutter**
  less than 0.1 of 1.0 per cent.

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  this Transcriptor. The braking is entirely mechanic

- **THREE SPEEDS**
  3¾, 7½ and 15 inches per second.

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...rs in the 20s

...ving information on radio amateur ...he 1920s is a continuation of the ...shed in the September and November,

...pening of the short waves in 1923-24 ... year saw a consolidation of amateur ...is portion of the spectrum.

... working was soon commonplace. ...n different countries were being made ...ally as amateurs moved their trans- ...encies higher and higher.

...ing news covers the period late 1924 ...25.

...er, 1924, a number of amateurs were ...only on short waves. Frank Bell, ...Zealand, contacted France using this ...mission. A few days later Ivan ...C, also from New Zealand, worked ...American CBF using 120 metres and ...n a 50-watt tube in a Hartley circuit. ... was a three-coil regenerative detector ...dio stages.

...mated that there were 100 radio clubs ...t this period. The W.I.A. and other ...avoured to organise an Australian ... League, the counterpart of the ... a message-handling body. "It could ...suitable value to our huge continent in ...national emergency," was one reason ...he formation of the league.

...organisation was not to be; they were ... only in countries where third party ...dling was permitted.

...egraph and telephone services were ..."utilities no third party traffic was ...n countries where such facilities were ... private companies, as in U.S.A., ...e permitted to handle messages.

...tsburgh, Pennsylvania, was the station ...at this time. It was the first inter- ...t wave station audible in this country, ... operated by Westinghouse on 63 ... special transmission to Australia was ...ver 2BL, the first presentation of this

...were gradually moving higher in fre- ...n February, 1925. Bill Dawson, 3AL, ...New Zealand, was working with ... San Francisco, on 39 metres.

... used at the time were invariably ...ts" three coils—aerial, grid and re- ...a regenerative detector circuit plus ...stages. Oscillating detectors were often ...blem. Quite an amount was written ...ect of the breaking-up of overseas ...is means and by unnecessary trans-

...HT WORKING

...ash from Paris stated that a French ...overed that simultaneous short-wave ... could be made on the same aerial. ...d 90 metres were used to transmit ...oss the Atlantic.

... of daylight working on the short ... long distances was in March, 1925, ...n station 2OD was in contact with W ...0 metres. It was stated that Austra- ... could not operate below 40 metres ...ge:

... that radio will give better results by ... might on a wavelength of 20 metres ... been established in America, where ...munication has been made across the ...Twenty metres is a very short wave, ...ssible to design and obtain apparatus ... to five metres. The chief difficulty ...ively short waves is that the terrific ... the impulses may, and often does, ...s. As the valves for this long-range ...ost up to £20 few amateurs venture ...iments with very short waves.

...tres is a wavelength which a few ex- ... in Sydney could reach with their ...pment. No one is likely to have ...r a 20-metre wave."

...W. division of the W.I.A. arranged in ... for the transmission of "standard ... over VK2WI. Harry Stowe (2CX) ...ransmissions on wavelengths between ...metres. In early 1926 they were ex- ...pver down to 20 metres.

...of the forthcoming I.T.U. conference ...equency allocations to be held in ...1959 and the battle for frequencies ...a cable, dated April, 1925, will be of

...national Wireless Congress held in ...ranged the following scale of wave- ...amateur two-way operation:

...Three choices between 115 and 95, ...or 47 and 43 metres.

...120 to 115 and 43 and 41½ metres.

...tates—85 and 75 metres and 41½ to ...es.

...of the world—95-85 metres and 37½

... this month that daylight working was ...between Australia and Europe. The ...was made on April 15, when the late ...arcan, VK2CM, QSOed G2KS and ... a single 50-watt valve.

...ation was established between 4 p.m. ...E.A.S.T., via the long path, a point ... appreciated at that period.

...gal contacts with Europe were made ... mornings here in Australia on 90 to

...information on amateur radio activity ...will appear in future issues.

"NOVATAPE"

SALES ARE STEADILY RISING because of **SUPERIOR DESIGN AND PERFORMANCE.**

There is no other **3-SPEED** recorder, no other recorder sold with a **ONE YEAR GUARANTEE** no other recorder of such **SIMPLE AND RECENT DESIGN.**

A REVOLUTIONARY DESIGN OF **"SONIC-MIDGET"**

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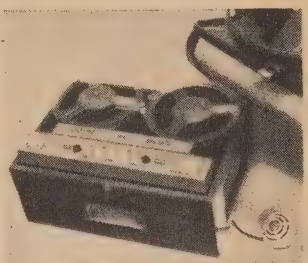

3 Speed
3 Motor **"STUDIO"**
2 or 3 Heads, single ended, 4-watt, or push-pull 10-watt. Magic-eye or Meter Level Indicator. Place finder. Single Knob Control.

★ Simple and efficient ONE-KNOB tape Control. No spilling of tape ★ 40 second Fast Forward and Rewind ★ "Differential" Brakes ★ Counter, Place-finder (Built-in) ★ Guaranteed Frequency Response. ★ 1-year written guarantee.

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FOR EVERY TYPE OF VALVE, "Nova" pioneered "Ultralinear" in Australia.
UP to 12 WATT (2 impedances). £4/17/6. UP to 20 WATT (2 impedances). £6/3/-.
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TRANSISTOR Transformers to R. and H. and other specifications.
Rewinds and any type transformer or coil to customer's specifications.
Call, ring or write for quote on your needs.

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CUT OUT HERE

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AND 636 KING STREET, NEWTOWN

EVENINGS and WEEKENDS "KAULA," HILMA ST., COLLAROY PLATEAU — XW5
DULWICH HILL, UNDERCLIFFE, EARLWOOD, TRAM AT DOOR, STOP No. 42

THE OUTSTANDING 10-VALVE HI-FI

RADIOGRAM CHASSIS

Incorporating Mullard 5/10 bass boost amplifier, treble boost dual wave tuned R.F. stage. Built in pre-amplifier for microphone or tape recorder including Jensen twin speaker.

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THE FINEST SET AT ANY PRICE
CHECK THESE EXTRA FACILITIES

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Hear it demonstrated on these units.

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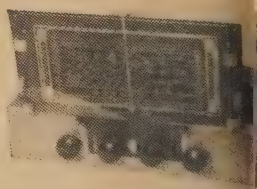
CABINETS AND ALL ACCESSORIES TO SUIT



Dual-wave, 6 valve radiogram sis includes bass and treble b 12in Jensen or Magnavox spe

£23/15/-

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Dual wave bass and treble tuned R.F. stage, 12in speak

£28/17/6

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PUBLIC ADDRESS RANGE 240-AC

6 valve 10 watt £14/17/6
6 valve 25 watt .. £25/7/6
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BATTERY ONLY OPERATION

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6 valve 10w 6v £20/15/-
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£34/15/-

Complete with Jensen twin cone speaker, Ferguson O.P. transformer 301 and U.I. taps.
MULLARD 5/20 as Above.

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Tuner and separate control box with mike pre-amplifier.

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Complete with EHT Box and Brackets £3/12/6
Chassis for 5in £1/17/6

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R TV & H KITS

Complete Kits

17in with wired and tested Steanes Strip and Philips Turret.

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5in R. TV. and H. Kit modified for 6in VCR97 .. £62

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Steanes Pre-aligned

Mark 1 .. .. £20
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For Mark 1 with chassis sockets and Circuit Diagram, £6/10/-.
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For 17in or 21in .. £7/5/-
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NEW ALTEC LANSING THEATRE H.F. SPEAKER UNITS,

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R.T. & H. 21" TV CHASSIS

Now on display at Newtown and Collaroy.

SEE IT IN OPERATION

The complete kit of parts, including wired and tested Steanes or R.C.S. I.F. Strip and Philips Turret Tuner.

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Console or TV Gram Cabinets to suit.
Set can be supplied wired and tested.

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A complete range of Antennaes to suit all areas.
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For all your TV needs, Better Service, Lower Prices and Practical Advice and Assistance, contact A.C.E., any hour.

4 SPEED PLAYERS £11/17/6
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5 VALVE RADIOGRA CHASSIS

DUAL WAVE SPEAKER

£18/15/-

5 valve also availa home constructors 'K
Complete with circ

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7 VALVE DX RECEIV

3 band, 2 to 6 to 1 160 to 16 metres and cast. Exceptional sel sensitivity 2 microvolts Australians, listen to pean short wave stati

£29/17/6

ALUMINIU CUT TO SI

16 Guage, 6/- sq
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COLLARO T. DECK

With 5-Valve Amplifier, Crystal Mike.

£69/15/-

With Built-in Tuner Am

£85

Only the Cabinet required Tape Recorder.

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Communications Receivers

Converted to 240v. A.C. ...chly Tested. Re-aligned. ...valtone Permag. Speaker.

£34/17/6

...W RESISTORS

...) assorted. 40 values.

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Postage 2/6.

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...P.F. to 30 MFD. ...rted. Mica Paper Electro.

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...' 24V MOTORS

...und. Hi-speed miniature ...PM £2/10/- ...und with gear box, 2 speed ...d 25 RPM £2/10/-

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...A.V. 80 amp. Generators. ...lighting or fast chargers.

£10/10/-

...likes. New ... 3/6
...watt Prefocus Globes 7/6

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...tested on TV picture. ...h shield and socket, £3/17/6 £2/17/6
...and Shield ... £3/-/-
...White. 5in ... £3/10/-
...12in Magnetic Deflection ...s. Blue Screen. ...

£3/10/-

...he capable of perfect pic-...ast persistency and simple ...ion, using standard com-...ponents.

...NEW 3BZ ...RANSMITTERS

...ration. 2 to 10 Megs. ...tested. Perfect order ... with P.M.G. requirements. ...ll ships, bushfires and all ...rvices.

...TE WITH 1 CRYSTAL.

£32/10/-

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...ss valves and meter, £3/-/- ...including valves and meter, £4/10/-
...ss valves and meter, £3/-/- ...including 15 octal valves and ...o amp. meter ... £5/15/- ...ll these units are in excel-...dition. For original use, ...rts or conversion.

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2/6 ea. 25/- doz.

NEW GAS FILLED VIBRATORS

12 volt.
Heavy-duty. Synchronous.
Suitable to 400v. 150 Ma

£1/-/- Postage 2/-.

AR8-AT5 — COMPLETE STATION

AIR TESTED

Transmitter-Receiver. Aerial Couple Cables: Plugs, Phones, Mike. 1 Crystal to desired Frequency. 24v. Power Supply and Circuits of 2 units.
GUARANTEED IN PERFECT ORDER.

£62/10/-

Other voltages available.

12V Lighting Plants

Johnston 300 watt direct coupled in 1 H.P. petrol engine. Tested. Perfect order.

£36.

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217C	10/-	VT502	12/6
12C8	12/6	7A6	7/6
6J8	17/6	AV11	3/9
VT501	12/6	832A	£3/-/-
2D21	15/-	6K7	7/6
6L6	20/-	12SJ7	12/6
1C6	12/6	12SK7	12/6
1G4	12/6	12SL7	12/6
1D4	12/6	39/44	10/-
1J6	12/6	47	12/6
1K4	12/6	78	12/6
1K6	12/6	828	£2/10/-
1LH4	12/6	843	£1/10/-
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6A6	12/6	1625	£1/-/-
3A4	15/-	1629	10/-
3B7	10/-	4307A	10/-
3D6	10/-	1619	£1/-/-
6AG5	9/6	2050	£1/-/-
6AM5	15/6	9001	8/6
6AM6	17/6	RK75	10/-
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6F6	12/6	EL3NG	12/6
VR65A/SP41	2/6	83	10/-
KT66	27/6	EM1	12/6
806	£3/10/-	866A	15/-
1K7	7/6	6AC7	3/6
6X5	10/-	EF50	3/6
6V6	12/6	100TH	£2/5/-
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6BM8	17/6	1R5	15/-
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		833	£15

NEW Indicator Unit

for that C.R.O. Project.
3 valves. VCR139A CR Tube. Cabinet. Socket Mount for Tube Pots, etc.

£3/17/6

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Complete with Filter. Hi-speed. Ball-bearing. 2 cu. ft. per minute. Ideal for small spray gun, etc.

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£1/15/-. Post 2/-

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50 cycle, 24 and 32v. D.C. to 240v. A.C. Ideal for Radiograms, etc.

£25/-/-

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6v., 240v. 40 watt	£3	7	6
12v., 240v. 60 watt	£3	7	6
32v., 240v. 60 watt	£3	7	6

C.R.O. TRANSFORMERS

350 x 350 extended to 1000v. 6.3v., 6.3v., 215v., 4v. £4/5/-
Postage: N.S.W., 5/-; Interstate, 7/6.

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8 valve

4 Band. 195 KC to 9.025 Megs. 24v. D.C. Operation ... £22 0 0
Converted to 240v. A.C. £33 15 0

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1700 SPDT	7/6
1300 SPDT	7/6
500 x 500 SPDT	7/6
12 volts DPDT 5 amp.	£1-/-
12 volts DPDT	12/6
8-16 volts DPDT	12/6
11 volts A.C.	£1/-/-
Hi-speed Polarised relay	£2/10/-
400 ohm	12/6
1300 ohm DPDT	15/

½in Square Section DURAL TUBING UP 24 12ft lengths, 1/- per ft.
Hi-lo Phone Transformers ... 4/6
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100 yards ... £2/17/6
Tx Var. Condensers. 300 pf. £1/5/-
100 pf £1/1/-
60 pf with Vernier £1/1/-
30 pf ... 10/-

128 TRANSCEIVERS

9 Valve Battery Operated Pack Sets ideal for fire and small ships service. Air tested, complete with Crystal to required frequency, all accessories and circuit except batteries Coverage 2 to 4½ megs.

£18/15/-

NEW HMV PICKUPS MAGNETIC

£1/2/6

2in Dynamic Speakers

Ideal for Transistor Sets or Miniature Portables

19/6

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£1/10/-

Postage 2/6

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8-day movement. Cost Govt. £28.
2¼in ... £4/15/-
2¾in with sweep hand ... £5/15/-

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Standard or miniature to suit all valves

Coils B/C, 455 KC	9/6
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GENEMOTORS

Input.	Output.			
24v.	250v. 100mA	£1	0	0
24v.	550v. 375mA	£2	0	0
24v.	250v. 60mA	£1	5	0
12v.	500v. 350mA	£8	10	0
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6v.	500v. 150mA	£6	10	0
24v.	250v. 100mA New	£2	0	0
12v.	235v. 50mA	£2	15	0
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COMMUNICATIONS

New 1155 four band coil boxes 200 Kc to 17½ megs.

£5/15/-

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Standard P.M.G. Type
Pedestal Magneto Phones. Tested. In perfect order.

£6/10/-

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E.M.I. and Scotch. Hi Coercity

Excellent Condition.	Ex ABC.
1200 ft. Spools	£1 8 6
600 ft. Spools	18 6
3250 ft. Platters	£2 10 0

TRANSCEIVERS NEW No. 122 & 22

2 to 8 megs as above. Converted to Crystal Control. Power increased to 20 watts. Includes Plugs and Cables, Mike, Speaker. Circuit. 2 Crystals to wanted frequency conforms to P.M.G. requirements for small ships and other services. £33/17/6

WANTED

Communications Receivers, Test Equipment, P.A. Gear. Large or small surplus stock. Best prices. Call, write or phone any time.

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1UF	600V	6/6:	5UF 2.5V 6/6
4UF	750V	12/6	5UF 400V 6/6
10 MFS	500	7.5UF	330V AC, 10/-

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550v. 350mA	£8.10 0
250v. 100mA	£2 15 0

OSCILLATOR UNITS FOR 144 MEG. OPERATION
Complete with 2 Valves.

19/6

Power Transformers

1500 x 1500v 750mA

£8/10/-

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229 Elizabeth St., Melbourne

Bargains in Ex-Govt. Technic Equipment and useful Gadge

MAIL ORDERS TO BOX 5234
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- SYDNEY: 96 OXFORD ST. (MAIL OR TO BOX 22, OXFORD ST P.O.)
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WALTHAM'S FOR VALVES

Special Prices for Quantities

1D8	8/11	7C7	1/11
1Q5	8/11	CV66	5/-
1T6	7/6	7W7	2/6
6A8	12/6	807	19/6
6AC7	2/9	811A	19/6
6AU6	3/9	954	3/11
6C5	7/6	955	3/11
6H6G	1/6	785A	15/-
6J5	2/11	12SR7	7/11
6K7	3/11	1626	5/-
6K8	9/6	1629	7/6
6N7	9/6	AV11	5/-
6SH7	2/11	CV66	4/6
6U7	6/9	EF50	2/9
6X5	4/6	VR65A	2/6
6Y6	12/6	VR78	7/6
7A6	5/-	VR100	4/6
7A8	5/-	VCR132	50/-
7C5	5/-	2AP1	nil

Please add postage.

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A Scientific Instrument, Precision-Built: Four Types.

No. 605 7½in long (1in wide, in card-board case. 55/- each

No. 450: 6in x 1in, fitted with magnifying cursor. In leather pocket case. PRICE 50/- each

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No. 28 (Circular type) Diameter, 5in in plastic cover. PRICE: 25/- each

Packing and postage 2/-.

These Slide Rules are complete with Instruction Manual.

SANWA MULTIMETERS

MODEL SP5. 2000 ohms per volt AC DC. Voltages: AC DC from 0-1000 volts in 5 ranges. Current: 0-500 m 3 ranges. Two resistance ranges. Measures inductance: 10H-1000H. Measures capacity: 100PF to .03 U.F, .01U.F to 1U.F. PRICE £7/10/-

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Ex-R.A.A.F.

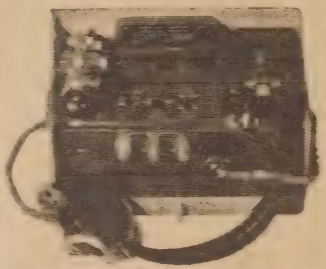
12-V., 30 watt. Sturdily con-structed, with 6in. dished re-flector and peep sight. Two mostly grips and trimmer switch.

Complete with 2 spare globes

PRICE 39/6. Additional spare globes 3/6 each. Packing and postage 4/- interstate 8/6.

CALLING YOU FOR A SPLENDID BARGAIN

MORSE BUZZER SETS



Complete with headphones. And at the VERY LOW PRICE OF 32/6. You should call and see these; or if you send a mail order—packing and postage is 11/6.

BATTERIES. 1.5 volt, suitable for Morse Buzzer Sets. PRICE: 3/6.

TRANSFORMERS, 39/6

395—Volt—395 Volt.
240-Volt Primary.
5-Volt 6.3-Volt C.T.

CHOKES. 15 H. 200 Ma., 50/-.
Packing and postage (all States), 8/-.

WATCHMAKERS' EYEGLASSES

PRICE: 6/6.

Extra Strong—10 Magnification. 15/-.
Jewellers' Screwdrivers, Set of 5, 13/9.

PRICE: 15/-.

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TANK WHIP AERIALS

Make Good Car Radio Aerials or Fishing Rods.

3 sections (12ft.), 22/6; 2 sections (8ft.), 15/-. Rubber bases for these, 12/6. American screw-in type, 3-4ft. sections, £1/19/6.

METERS; GOOD RANGE

0-100 Micro-amp.	£2/10/-
0-50 Micro-amp.	£3/10/-
0-50 Micro-amp.	£3/15/-
0-1 Ma., 1in. square	37/6

Packing and postage, 3/6.

USEFUL DURAL TUB

There's a Great Demand for This strong metal tubing can b for many purposes, includin aerials. We have this tubing i sizes —

Diameter	Gauge	Price
1/4in.	20	
7/32in.	20	
9/16in.	22	
1/4in.	16	
5/16in.	16	
7/16in.	16	
3/8in.	16	
3/8in.	17	
9/16in.	17	
7/16in.	18	
1/2in.	18	
5/8in.	16	
1in.	20	
15/16in.	20	

(No Mail Orders for Dural Tubin

SCR 522 TRANSCEIVERS

Can be converted to 144Mc.

PRICE: £19/10/-.

Packing and delivery to railhea No. 11 Transceiver Vernier

PRICE: 17/6.

Packing and Postage (all State

DALTON COMPUTO

Aircraft navigational. Hinged fl ICAN calibration in front.

PRICE: £5.

Packing and postage, 4/-; interst

MICROSCOPES

Ideal for Students

Single Eye Turret Model. 300 Magnification. Provides not only many hours of pleasure, but fascinating discoveries for the whole family.

PRICE: 79/6.

Packing and postage, 3/6; interstate, 4/6.

SWITCH MAGNET RELAYS

5/6 6/4V 30 amps. 40 vol

PRICE: 12/6.

Packing and postage, 2

U/C SWITCHBORD RELAY

PRICE: 8/6.

Packing and postage, 2

'S BUY AN GUMENT

ntinued from Page 83)

hey say, you'd be selling petrol me!"

g weakness in the argument for output impedance lies in the itself and the fact that its cone e coil cannot be regarded as a nogenous assembly.

w frequency components, cone e coil may indeed move as one. good electrical control possible ip, independent vibrations may er sections of the cone, pro- coustic output which is not dir- ated in phase or amplitude to l movement.

independent vibration cannot ly be subject to much control voice coil or anything operating

eing so, negative output impe- ay be of potential value only in region. Elsewhere it may well bility, in that it will cancel in benefits of the normal negative loop.

OBLEM

ard it argued that this last is no You simply provide so much feedback to start with that there left after cancellation. But it's asy as that.

tested plenty of high quality ial amplifiers, and I mean world- l makes, which haven't too much in the matter of high frequency They show peaks in the spec- ove 40Kc and ring noticeably cited by 1 to 5Kc square waves well imagine the feelings of the if invited to add still more feedback, let alone an additional feedback loop into the bargain. own case, we have seen fit, very , to limit the design of home- plifiers to 20db negative feed- figure which gives good charac- with adequate stability margin, ng the transformers which read- More feedback? Positive feed- Well . . . . (much musing, etc.)

PASSE

is point we reach the familiar There is no proof at the as to how significant supersonic re to wide-range reproduction, how much intermodulation and stortion one can afford to toler- erefore one cannot say with any how much potential high fre- tability and/or linearity one can low frequency cone control— a swap is necessary.

ing this, I'm not seeking to dis- ie article referred to by W.H. verdict on his own amplifier. I'm just trying to emphasise that there are "cons" as well as "pros" to the circuit. Time will tell, even if we don't.

As for the acoustic method of analysing the performance of an amplifier system, no one possibly questions its advantage. The big trouble is that few laboratories are equipped to carry out such tests.

So much for amplifiers. From a regular correspondent, M.G., comes some comment as appended on the subject of transformerless radio and TV receivers. M.G.'s opinion is valued but I feel that it doesn't add anything to the discussion: in fact, that's why I reprinted it.

It represents the line of thought to which reference was made—transformerless sets can be made initially safe if you provide a variety of safeguards.

But the matter doesn't end there. As I said in the original article, the hazard arises as age and mishandling or faulty components invalidate the precautions one by one—without the set owner realising it.

RADIO and TELEVISION ACCESSORIES

RADIO. We specialise in Radio Parts and stock all reliable brands including Resistors, Coils, IFs, Condensers, Speakers, Valves, Pick-ups, Changers, Players.

TELEVISION. Turret Tuners, Picture Tubes, Valves, Transformers, Deflection Kits, Video and Sound Strip, Chassis (R. and H.), Sockets and Accessories.

DRILLS AND TOOLS. Black and Decker products. Sher Drills and Kits

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Wholesale Radio Distributors,

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Phone BA3917 **Open Saturday Mornings**

AIRCRAFT MAGNETOS

Contains sundry gears. Coil. Electrical and mechanical parts. **Only 9/6 ea.**

Freight payable at nearest attended railway station.

AMERICAN FIBRE PULLEYS

with good quality ball bearing

1 3/8 diam.	¼ Shaft,	2/6
1¾ diam.	¼ Shaft,	3/6
2 3/8in diam.	3/8 Shaft	4/6
3½in diam.	3/8 Shaft	5/6

Add Postage

RANGE FINDERS

Horizon, Tartzon and Bubble. Type, Brand new Mark IIIB. Complete with Leather Case.

Dimensions, 9in x 4in x 2in.

Ex-R.A.A.F. ORIGINAL COST £30.

PRICE 35/-

Post N.S.W., 3/2. Interstate 4/7

ALTIMETERS

BRAND NEW

£1 ea.

Post N.S.W., 2/1. Int., 3/3.

0-1 MILLIAMP METER

47/6

Post N.S.W. 2/1. Int., 3/3.

CATHODE RAY TUBE

TYPE 4/1 WITH SOCKET

New, 29/6 ea.

Post N.S.W., 2/6; Int. 3/11.

P8 COMPASS

RECONDITIONED AS NEW.

Liquid Filled. Ex-R.A.A.F., 4in diameter. Cost £35. Ideal for small boats, etc.

Special price

£3/15/- each

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LEVELS

with high-power telescope. Will do dumpy work. Cost £300.

Special £15 each

No. 19 TRANSCEIVERS

2-way Radio, with Genemotor and 15 standard valves Good Condition.

£7/10/-

Freight payable at nearest attended railway station.

Telescopes, Brand New

30-POWER. Coated lenses.

£5/15/- Post, N.S.W., 4/5 Int., 5/10.

TELESCOPES Ex-Army

Ottway of London. With variable power adjustments. Length 26in. Weight 12lb.

£12/10/-

Freight payable at nearest attended railway station.

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70 OXFORD STREET, SYDNEY Between Crown and Riley Streets, City.

TO CELEBRATE THE OPENING OF OUR

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ON MONDAY THE 3rd MARCH

Many lines have been drastically reduced as advertised on t
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3rd MARCH FOR ONE MONTH ONLY

*Visit our Stanmore and St. Peters Stores where hundreds of li
are to be cleared irrespective of cost!*

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WITH ALL ORDERS OF £5/-/- OR OVER SIX NEW VALVES SELECTED FROM T
FOLLOWING LIST WILL BE SUPPLIED FREE (COUNTRY ORDERS PLEASE A
2/6 EXTRA POSTAGE)

1Q5GT — 1C7G — 6H6 — 6H6GT — 6K7G — VR65A — EF50 — 954 — 6C
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***All goods advertised available at either Stanmore
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STANMORE, N.S.W.
PHONE LM7398

640 KING STREET, ST. PETER
N.S.W.
PHONE LA6087

TRANSCEIVER SPECIALS

o. 22 & 122 TRANSCEIVERS

2 transceiver covers a frequency of 2 to 8 Mcs. and en approved by the P.M.G. for use on fishing boats, raft, bush fire brigades, etc. if converted to crystal , for which it is easily adapted. These sets are d complete with valves, 12v. vibrator power supply. c headphones and microphone, leads.

£12/17/- F.O.R.

No. 19 TRANSCEIVERS

These units cover a frequency of 2 to 8 Mcs. and contain 15 6.3 volt valves including 1.807, 2-6V6, 6-6K7, 2-6K8, 6B8, etc., also 500 micro-ammeter

Units supplied complete with valves, leads, junction box, genemotor power supply and dynamic headphones and microphone (operate from 12v. supply). **£7/15/-** F.O.R.

lo. 11 TRANSCEIVERS

d complete with valves, high and low power gene- , leads, headphones and microphone.

£6/15/- F.O.R.

No. 108 TRANSCEIVERS

These 6-valve Walkie-Talkies are supplied complete with valves, headphones and microphone.

£7/15/- F.O.R.

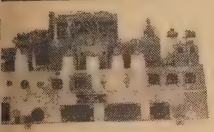
ALL TRANSCEIVERS ARE IN EXCELLENT CONDITION

PLEASE ADD 15/- FOR PACKING WITH ORDERS FOR ALL TRANSCEIVERS.

CAN HANDY TALKIE. SUPPLIED WITH VALVES BUT LESS COILS AND CRYSTALS. TYPE BC/611, £8/15/-. POST & PACKING 15/- EXTRA.

NEW INDICATOR UNITS

These new indicator units contain 3 valves, controls, etc., and V.C.R. ACR/10 C.R.O. tube and socket. Ideal for that small scope. **£3/10/** F.O.R.

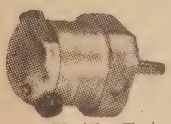


dar Receivers

radar receivers type ZC955 16 valves and a 30Mcs. p suitable for your TV experi- Units are in new condition.

/17/6 Packing 15/- extra.

24 Volt Midget Motors Shunt Wound



Fully Laminated Fields Wound Armature Sixteen Segment Commutator, ball-bearing. Ideal for Model Trains, Hobbyists, etc.

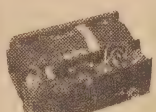
Condition New.
Price, each **25/-**

Packing and postage, N.S.W., 1/6; Interstate, 2/6.

NEW MN26 COMPASS CONTROL BOX 25/-

Flexible Drives For Above— 10/- Plus Postage

NEW SCR 522 GENEMOTORS



28 volt input D.C. regulated and filtered output filtered D.C. 300 volts at .26 amps; 150 volts at .01 amps; 14.5 volts at 5.0. Completely shielded in metal case. 12 x 8 x 5 inches.

Price, F.O.R. Each **27/6**

NEW 3in R.F. METERS

ed with New Scale to Convert to 0-10 or 0-100 METER. **7/-** PLUS 2/6 Postage.

LIFEBOAT TRANSMITTERS

These units use single 1.4V Valve and have Telescopic Aluminium Aerial **17/6** Postage 4/- Extra

O-AX. CABLE

90 Ohm Twin Co-ax. **YARD,** plus postage.

CO-AX. CONNECTORS

PYE TYPE _ _ _ _ _ **4/- Pr.**
AMERICAN _ _ _ _ _ **6/- Pr.**

New Throat Microphone

3/6 plus postage

NEW MICRO SWITCHES 5/6 plus postage

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540 KING STREET, ST. PETERS, N.S.W. — PHONE LA6087

NEW VALVES AT REDUCED PRICE

1Q5G	5/	6K7GT	7/9	7C7	3/6	954	
1P5G	5/	6U7G	6/6	7A6	3/6	955	
1C7G	5/	6Y6GT	12/6	78	7/6	12A6	
1K5G	2/6	6X5GT	10/	71A	7/6	EF50	
6AC7	3/6	6J7G	5/	EL32	10/6	110TH	£2
6C8G	7/6	6U7G	5/	KTW62/6U7	6/6	811	£1
6SS7	8/6	6J6	15/	VR65A	2/6	866 866A	
6F6G	9/6	6F8G	10/6	CV6	3/6	828	£1
6E5	8/6	6SH/GT	5/6	42	12/6	12SH7	
6H6	3/	6A3	15/	7193	3/6	12S17	
6H6GT	3/-					6K7G	
6J7G	7/6					100TH	
6K7G	6/					866	

Please add Postage on All Valves.

NEW POWER TRANSFORMERS

60mA prim.: 204v with 230v tapping, Sec. 285 x 285 with 6.3v filament winding.

22/6

Plus Postage: N.S.W. 3/6; INT. 5/3.

MICA CONDENSERS

Standard Mica Condensers, small current types, .00003 to .005, including most wanted values.

Per 100 20/- .. .. Postage 1/6

New Midget Power Trans.

40mA Prim. 250v Sec. 225 x 225 with 6.3v Fil. Winding. Upright or Flat Mounting. Size 2in x 2½in.

22/6

2/6 Postage, N.S.W.; Interstate, 4/6.

30mA, 240v Prim. 150 x 150v Sec. with 6.3v Fil Winding.

20/- Postage: N.S.W. 2/6; Interstate 3/6.

NEW ALTIMETERS

FIT ONE IN YOUR CAR

17/6

Post Free

NEW DYNAMIC HEADPHONES

These headphones made by Rola are a high quality unit giving excellent tone. Fitted with comfortable ear pads.

22/6

Post 4/6.

NEW No. 7 HAND MICROPHONE

with Switch Dynamic Unit.

20/- Plus Post.

VALVE SPECIALS

20/- will purchase any one of the following valve Specials.

4	1P5	3	6K8G
6	1C7	6	6SH7
4	1Q5	6	6AC7
12	1KS	5	6J7G
6	954	4	6U7G
6	6C8G	4	12AG
9	EF50	2	6X5GT
12	VR65A	7	6K7G

Post and Packing, 4/6 extra.

ALL VALVES ARE NEW.

NEW 6H6 OR 6H6GT VALVES

Individually Cartoned.

14 for 20/-

Post 2/6.

NEW TRANSMITTING VALVES

100TH	£1
866	12/-
811	15/-

NEW MICRO-AMMETERS

New Paton Micro-Ammeters.

0-500, M.A. 1¾in diameter. Flush mounting.

25/-

Post and Packing 2/6.

CONDENSER SPECIAL

Boxes of 100 new mica paper and electrolytic condensers in values ranging from 50pf mica to 5 400v paper. Values include .0001, .00025, .00075, .01, .02, .05, .1. Also 500 mfd/12v, 10 mfd/40v, 8 mfd/525v, 16 mfd/350v, electrolytics.

25/- per 100.

Post Extra: N.S.W. 2/6; Int. 3/6.

NEW VIBRATOR

A.W.A. Oak 6 volt Synchronou base

A.W.A. 12 V Synchronous oct

7/6. Post 1/6.

NEW PUSH BUTTON SWITCHES

Five pole push-button switches.

New control box fitted with above switch, also 5 bezels with globes and multi contact by key switch

Post: N.S.W. ... 2/

Int. 3/

NEW I.R.C. RESISTORS

I.R.C. carbon resistors, ½, 1 and in values 50 ohm. to 5 meg. in many popular sizes, 3T, 15T, 20 5OT, 100T, 250T, 500T, etc. (Standard resistor color code su

100 for 25/-

(Plus 1/6 postage.)

New High Impeda Headphones

27/6 P

Telephone Genera

New small telephone generator for bell ringing, etc.

10/6

Postage 3/- Extra.

GERMANIUM DIO

for that Crystal Set.

5/6. Post Free.

I.F. TRANSFORM

Standard I.F. Transformers, squ (1 3/8) 455 Kc permatuned.

(Plus Postage)

Please address all correspondence to 332 Parramatta Road. Stanmore, N.S.W.

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PHONE LM7398

640 KING ST., ST. PETER N.S.W.
PHONE LA6087

V TO ALIGN SUPERHET RECEIVERS

(Continued from Page 79)

n the receiver. If there are cores in the coils these can be maximum response and at the screwed generally inwards or outwards to make the receiver r correspond with any calibra- e scale.

frequency calibration of the is accurate the receiver dial against it, but it is often just swing to the nearest local adjust the calibration, revert- oscillator signal for final peak-

ceiver is an old style, with no djust, calibration can be cor- by re-setting the dial pointer. us attended to the low fre- d of the band the oscillator set to the 1,200 to 1,300Kc signal level reduced to the usable figure and trimmers maximum response.

same time, if need be, the can be worked generally in- utward to make the dial read

igning a superhet with instru- first step is to set the oscilla- 5Kc (or other desired inter- equency) and by feeding the signal through from the converter grid peak all IF transformer windings for maximum response.

One important point needs to be watched when doing this. In many IF transformers the adjustable slugs can be screwed right through each winding, so that two peaks can be found, one with the core passing from the end of the former into the coil and another with the slug passing beyond the coil towards the centre of the former and the adjacent winding.

Unless there are specific instructions to the contrary the core should always be peaked in the outer position, that is, furthest away from the centre of the former and the adjacent winding.

Peaking one or both cores to the inner position can upset the coupling and the shape of the IF selectivity curve and may increase gain sufficiently in some cases to promote instability and oscillation of the type already discussed.

Having aligned the IF transformers, the procedure for the tuning circuits is exactly the same as it is when using only station signals. The important difference is that the readily controllable signal from the oscillator, together with an output meter, allows the job to be done with greater precision.

ABOUT AUDIO AND HI-FIDELITY

(Continued from page 61)

luminium coil is by far the evice.

arly 10 years since I wrote ing in a little book:

eas response curves vary sly according to the method g them, and may even re- pinch of salt to aid digestion, dance curve at a given volume n be accepted as a statement

ords are just as true today re then. A perfect loudspeaker one which looks like a pure at all audio frequencies. The basic weakness of the electrostatic device is that, from the point of view of matching the amplifier, it looks like nothing on earth. Before Messrs Janszen, Pickering, Leak and Walker draw their revolvers and start shooting, I hasten to add that I am not insinuating that good and proper transfer of power is impossible; I only say it is a pity it is not easier and simpler to do. As it is not just a question of impedance, I have asked my colleague, Mr. Cooke, to draw up a summary of the problem involved, so that we can open Part 6 in the select company of the electrostatic speaker.

E UNIVERSE

(Continued from page 19)

was that that glorious orb in ky was born from a cataclysm

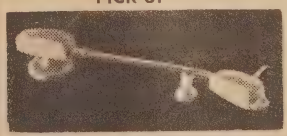
There it revolves in the outer space awaiting the time e visitor from earth will land ysterious surface. It is being with greater interest than ever its long history. Already its ave been surveyed and broken ilding and service station sites ising land salesmen. No doubt its have already worked out nd taxes for the lunar surface. ay be too late. If the Soviet n to it again (unless someone her planet has already beaten) there will be no land for the Lunar Soviet Socialist

I leave I must tell you about who could easily understand find out the distances of all the planets and what they are made on, but he thought it really how they found out the names

ght.

AWA RONETTE

Wide Range FONOFLUID PICK-UP



Turnover head for standard and long play.

FF2 12" Arm £7/16/11

FF3 16" Arm £7/16/11

CHANDLERS

Albert and Charlotte Sts., BRISBANE.

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Electrical Instruments

METERS:

4½" x 4" Polystyrene case. All ranges and scales available

0-1 Milliampere £4 16 0

0-100 Microampere £6 0 0

0-50 Microampere £7 0 0

MULTIMETER KITS:

Model KT1 .. .. £12 0 0

Model KM4 .. .. £9 0 0

V.T.V.M. KIT:

Model KVM £22 10 0

PARTS:

Prods, Plugs, Knobs, Switches, Meters, Probes, 1% H.S. Resistors.

ALL GOODS PLUS 12½% SALES TAX

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512 ELIZABETH ST., MELBOURNE C.1

Large and varied sto
at
Astonishingly low pri

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SPECIAL OFFER!

METERS!

Brand new.
British made.

0-1 Milliamp Meters, 2½in **50/**

0-5 amp Meters, AC-DC, 2½in dial .. **45/**

50-0-50 amps **50/**

0-1 Miniature Milliamp Meter, 1 1/8in, ... **37/6**
0-14 amps, AC, DC, 4½in dial. **65/**
0-25 amps, DC, 3in. **29/6**
0-200 amps, DC **£4/10/**
20-0-20 amps, DC **37/6**
0-200 amps, AC-DC, 3½in. .. **£4/19/6**
0-150 milliamps, DC, 2½in. **27/6**
0-20 volts DC, 2½in. **22/6**
0-30 volts **30/**
0-50 micro amps, 1 7/8in . **£3/10/**
0-100 micro amp meters, 1½in **50/**
0-30 V. AC, DC, 2½in. **45/**
0-300 Volts, AC-DC, 4½in dial, **£6/10/**
Packing and Postage, 3/6; interstate, 5/

INNER FLYING SUITS

(KAPOK-FILLED)

A very convenient thing for use as TRACTOR SUIT, TRUCK DRIVING, etc. Full-length zipper in front, also on legs. The

PRICE IS ONLY 37/6.

Packing and postage, 5/6; interstate, 6/6

VERNIER CALIPERS

Measures in inches and milliameters. Complete with depth gauge.

PRICE: 14/6.

VERY SPECIAL OFFERS

Magnifying glasses, 8 mags., **8/6**; 10 mags., **12/6.** Tapped Transformers, 6, 12, 18, and 24 volts, 3 amps, **45/-.** Genuine Army Telescopic Sights, **£9/19/6.** American Oxywelding Torches, **£5/10/-.** 24 volt, 1,500 watt Generators, **£12/10/-.** Brand new 0-1 English Micrometers, **18/6.** Ball-bearing Step-down Gear Box, 50/1 reduction, **39/6.** Steel Masons' Squares, 24 x 12, **14/6.** Cork Life Jackets (New), **25/-.** Long-nose Pliers (English), **9/6.** Spark Plugs (7-8in.), suit most old cars and tractors, **2/6.** Flying Goggles, complete with spare lenses, **17/6.** German Jack Planes, **25/-.**

(Please add Postage)

Shooters! Sightseers!

TELESCOPES GOING CHEAP

20 magnification, pigskin carrying case, pocket size, very handy, **£5/5/-.** 30 mag., with tripod, **£10/19/6.**

Packing and postage, 7/6; interstate, 10/-

MICROSCOPES

AN EXCEPTIONAL OFFE

A splendid gift for any person — either young or grown up. This instrument is much more than a toy; it can provide many hours of study. 300 magnification.

PRICE: 79/6 EACH.

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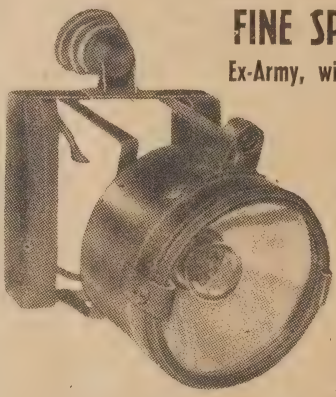


FINE SPOTLIGHTS; 12 VO

Ex-Army, with long beam; ideal for sh

Can be useful in cars, trucks, bo
Has twin handles; trigger switch
spare globe.

PRICE: 39/6.

Packing and postage, 6/-; interst
NEVER BEFORE AT THIS

UNIVERSAL FLEXIBLE LE

With ¼-inch Chuck.
44in. long. **PRICE: 95/-**

Grinding and engraving burrs, six, **2/-.** Polishing brushes, **6d** ea
ful for hobbyists, die-makers, e
garage men, plastic workers.
Packing and Postage 5/-; Interst

STUDENTS' DRAWING SETS

Encourage the budding artist to develop latent talent.

PRICE: 7/3. Packing and postage, 3/6.

LEATHER FLYING HELMETS

Ex-R.A.A.F. Takes Standard Gosport tube.

Price: 50/-. Packing and postage, **3/6.**
Gosport Tubes, **50/-.**

Safety Belts as used in Aircraft

Highly recommended for car trials. Quick-release catch. Complete with body harness. **Price: 19/6 each.** Packing and postage (all States), 3/6.

BRAND NEW LEVER TYPE GREASE GUNS

Ideal for all types of Trucks, Tractors or Cars, 7500lb pressure.

PRICE: 53/6.

Packing and postage, 5/-; interstate, 8/6.

BINOCULAR

FIN
QUA
All Bra
7x50
10x50
12x50
16x50

All coated lenses; complete pigskin case.

Packing and postage, 5/-; interst

NOW SUMMER IS HE

SUN GLASSES

R.A.A.F. Type .. .. **Pri**
De-Luxe Type .. ..
Packing and postage, 2/

VERY USEFUL IMPLEME

Watchmakers' Tweezers **6/6**
Watchmakers' Eyeglasses .
Extra Strong double lens Eyegla
Screwdrivers, set of five .. ..
Packing and post, 3/-. All

NSWERS TO CORRESPONDENTS

urstville, N.S.W.) writes to the Ser-
o Tells suggesting that he publish
ticism of commercial receivers from
in order to assist the public in their
ceivers. He also makes some caustic
garding the design of many sets,
with regard to the servicing angle.

thanks for your letter and comments,
we will pass the letter on to the
or his possible comments. However,
ore problems to the proposed articles
nagine and we doubt whether they
easible. Nevertheless we agree that
e criticisms which you level at in-
are true. Our experience is that, in
a letter to the makers will do more
you might imagine, since no firm
o stay in business likes to hear of
customer.

e Cove, N.S.W.) writes to find out
replace the ECC35 with a 12AT7
4 with a 6V4 in the Junior Signal

ubstitutions should be quite in order,
2AT7 will most likely operate satis-
this instrument without any circuit
Should the gain be not quite high
cathode resistors could be reduced
00 ohms. The only change that is
mechanical, in that the sockets will
changed to Noval types.

eelong, Vic.) wishes us to suggest
of cheap radio books with which to
studies.

tunately it is not as simple as it
to recommend books of the type
Titles appear and disappear with
regularity from booksellers' stocks.
recommended one month may be out
ouple of months later, being replaced
was previously unobtainable. Then,
ent booksellers have different books
times, and prices vary as well. We
your best plan would be to write
rest technical bookseller and ask for
ice list of books in stock.

ensington, Vic.) is one of our younger
appears to be very keen on radio,
details of two voltmeters and a small
t he has made. He suggests that the
s might be of interest to other readers
hether it would be possible to add
e to the two valve set.

thanks for your letter, P.J.H., and
l circuits for the "Reader Built It"
However, these could not really be
multimeters, since they measure volt-
though they are no doubt extremely
pite of this limitation. The other
would query is the provision of so
s, many of which are performing
tions. The usual convention with
ltimeters is to make each range be-
ind five times the previous one, since
found in practice that this is a very
compromise between adequate cover-
minimum number of ranges. In any
best to increase the scales by a de-
le, rather than random additions. Re-
addition of another valve to your
this would be quite feasible, but it
ecessary to consider what order of per-
s required from the new arrangement,
s justified a larger HT voltage, and
of bias would be required and how it
nost easily obtained. It would also
e to use a power output valve if any
volume was required. A 1F5 would
l type in this range.

llawood, N.S.W.) is interested in short-
itters and receivers and asks a num-
tions on this subject.

have published a number of trans-
its in the past, varying from very
he largest allowed under the Amateur
Many of these use receiving type
while others use one or two special
are more suitable for larger trans-
ou will need to reach the age of 16
e you will be entitled to hold an
perator's Licence. Satellite signals
ibly have been received on a simple
generative receiver, provided the oper-
illed in its operation, and knew just
when to listen. Some of the valves you
be suitable for use in such a set
he moment there are no such signals
We suggest you return the speaker
ers for their advice regarding repair.

Buchan, Vic.) sends us a subscription
ths and expresses his appreciation of
e and the friendly style in which the
written. He makes several suggestions,
portable set for "rough-and-tumble"
e outback (directed at drovers, rail-
s, etc.), an explanation of impedance
d to the matching of pickups to pre-
and a new form of terminal strip.

thanks for your subscription, H.W.S.,
ur comments about the magazine. Your
about the "rough-and-tumble" set is an interesting one, and we will keep this idea in mind. It would certainly be easier to fulfill the requirements by using transistors, and we may have to wait until these are available. The impedance to which you refer is the impedance presented to the pickup by the amplifier, or the impedance of the amplifier input circuit. In many cases it may be provided by nothing more elaborate than a resistor of the same value used in the grid circuit of the input valve. Your suggestion regarding the terminal strip is an ingenious one, but we have our doubts whether it really offers so much over the current design. In any case it would be of more interest to a manufacturer — and who had the necessary production facilities available — than it would to us. All we could do would be pass it on to such a firm, and it might be more satisfactory from your point of view if you made a direct approach.

G.C.M. (Dalkeith, W.A.) has built the Two Stage Transistor Set of June, 1953, and is obtaining excellent volume from it. However, he is worried about the limited selectivity of the set, and wants to know if there is any simple way of improving this.

A.: As with all simple sets of this type, G.C.M., there is no easy way of improving selectivity. The best that can be done is to select a suitable compromise between signal pickup and selectivity, by reducing the aerial size or coupling to the set. The latter could be achieved by tapping the aerial connection closer to the earthy end of the coil (see coil details, May, 1955). If you have volume to spare it may well be that you can achieve a worthwhile improvement by this means.

W.A.W. (Paddington, N.S.W.) has built the Set For Young DXers described a few years ago and is now interested to know about the procedure for collecting verification cards from both amateur and commercial stations.

A.: While there is no rigid procedure, stations both amateur and commercial are usually interested to know how their signal is being received and will acknowledge any useful reports by forwarding a verification card. The things they are interested to know are the time, approximate frequency and signal strength. If you mention, in general terms, the type of receiver you are using it will better enable the station engineers to judge the strength of the received signal. The amateur call books will give you the addresses of amateur stations but you may find it more difficult to obtain addresses of some of the commercial stations. Sometimes they are given by the stations themselves or you may find them listed in the short-wave page of this magazine.

R.P. (Pymble, N.S.W.) writes, "The volume control on our radiogram produces a lot of static when turned. It has been in the set for two months. The previous control was replaced by the electrician for the same reason as the present one. Could you tell me whether a new control is required or something else is the cause?"

A.: We presume that the radiogram is of a sound design and that the volume control is not in an unduly critical positon. Then there are two possibilities. Either you are unlucky in that the replacement volume control was faulty or there is another component in the receiver which has failed and caused the volume control to become noisy. Only a check by a competent radio technician could determine with certainty which is the case.

B.S. (West Kempsey, N.S.W.) wants to know whether we have ever described a complete transistor portable and also what type of transformers were used in the experimental transistor set of August, 1955.

A.: As we have pointed out on several previous occasions, we have not described a transistor portable so far. Nor do we intend to do so while the supply of transistors, coils, IF's, and audio transformers remains so indefinite, since there is little point describing a set which our readers cannot build. The transformers you refer to, B.S., were supplied by local transformer manufacturers. Ferguson Transformers were one firm who helped in this matter and you may care to contact this organisation direct.

G.M. (Brighton, Vic.) And All Other Interested Readers. It is not permissible to use a radio transmitter of any kind, regardless of the power, frequency, or purpose for which it is to be employed, without a licence from the P.M.G.'s department. This is a law which is enforced most rigidly, and any person breaking it is liable to severe penalties. For full details of the requirements for any particular licence, experimenters should contact the Radio Inspector at the G.P.O. in their nearest capital city. The circuit you submit, G.M., is a very simple one which is unlikely to be approved by present day standards. Your Vocational Guidance Officer would be the best person to advise you regarding a career in radio, but he will probably suggest that you obtain a job with a suitable firm when you acquire your Intermediate Certificate and take a trades course at the Technical College, or that you continue to Leaving Certificate standard, and then take a Diploma or Degree course at either the Technical College or the University.

W.D.S. (Wagga Wagga, N.S.W.) wishes to modify an older model commercial receiver which uses a mixture of directly and indirectly heated valves, and which originally operated from batteries, to operate from the power mains.

A.: While it would be possible to include a filter network especially for the battery valves, we feel that this is hardly likely to be worth while, especially in a 20-year-old receiver. Probably the cheapest way out would be to buy some indirectly heated valves from the disposals dealers. A 6U7-G, 6K7 or similar would work well in the RF amplifier socket, while a 6A8-G, 6J8-G or a 6K8-G would probably do a good job as a converter. These valves will work quite well with 130 odd volts high tension.

The Radio, Television and Hobbies Query Service

All queries concerning our designs, to which a POSTAL REPLY is required must be accompanied by a postal note or stamps to the value of TWO SHILLINGS.

For the same fee, we will give advice by mail on radio matters, provided the information can be drawn from general knowledge. UNDER NO CIRCUMSTANCES, however, can we undertake to answer problems involving special research, modification to commercial equipment or the preparation of special circuits.

Whatever the subject matter, we must work on the principle that a letter is too involved if the reply takes more than 10 minutes of our time.

Queries not accompanied by the necessary fee will be answered FREE in the columns of the magazine and presented in such a way as to be of interest to other readers.

To those requiring only circuit reprints, &c., we will supply for TWO SHILLINGS diagrams and parts lists from our files covering up to three constructional projects. Scale blueprints showing the position of all holes and cut-outs in standard chassis can be supplied for 5/-. These are available for nearly all our designs but please note they do NOT show wiring details.

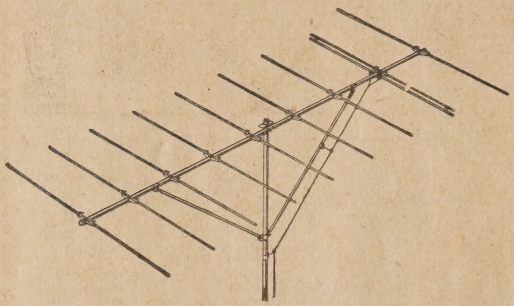
Address your letters to The Technical Editor, RADIO, TELEVISION and HOBBIES, Box 2728C, GPO, Sydney.

Note that we do not deal in radio components. Price quotations and details of merchandise must be obtained direct from our advertisers.

NEW TV AERIAL

from the Antiference 1958 *Snap-fast* ra

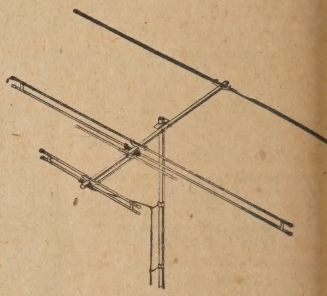
MODEL 108



A superb 9-element, low-band yagi, designed expressly to provide the utmost practical gain from a single aerial on Channel 2. Particular attention has been paid to providing wide element spacing so as to attain maximum gain whilst still enabling efficient impedance matching to a 300-ohm line, making it the largest aerial yet produced in Australia. It is outstanding for use in deep-fringe areas in combination with one or two model 208 high-band units.

Model 108 is also extremely useful where ghosts or interference are troublesome in nearer areas, as its acceptance angle of 18 degrees, which is exceptionally narrow for a low-band aerial, gives it a greater power of rejection against unwanted signals or interference.

MODEL 211



Model 211 provides a good standard of performan high and low bands at an economical price. Its directivity on the low band are achieved by p reflector for the low-band aerial. For the receptio band signals, direct pick-up by the high-band pic making three active elements.

Especially suitable for nearer areas where sensitivity and directivity are required on both

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'Phone: MX 1104, MX 1197

TO BUILD PORTAGRAM

(tinued from Page 70)

'VC tubing, held in place by rew and cup washer, should oopstick in place.

nmercial loopstick may be ou can make your own by oil of wire on a former which the "stick."

s made with a flat strip stick wound on a thin card former nough to slide along without y. The coil had 60 turns of enamelled wire close-wound, in place with coil dope. The correctly positioned about ¼ one end, the exact spot being noving it slightly while listen- low frequency station. The trimmer is used for adjust- high frequency end.

pleting the wiring, the connect- layer unit should enable you he performance of the gram. d players are designed to op- een about 200 and 240 volts, ans that in the majority of are operated at higher than voltages.

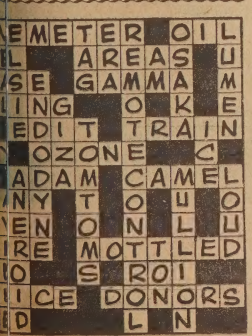
er units excessive torque can ble and vibration that will be by the pickup cartridge.

VOLTAGE

nd the insertion of a series the AC lead, beneficial in he torque by dropping the tage to about 200 volts. The sistance required will vary but not be less than 2,000 ohms than 3,000 ohms. Obviously s will have to be taken to in- resistor well and to keep it nductting surfaces. A 20 watt ould be adequate.

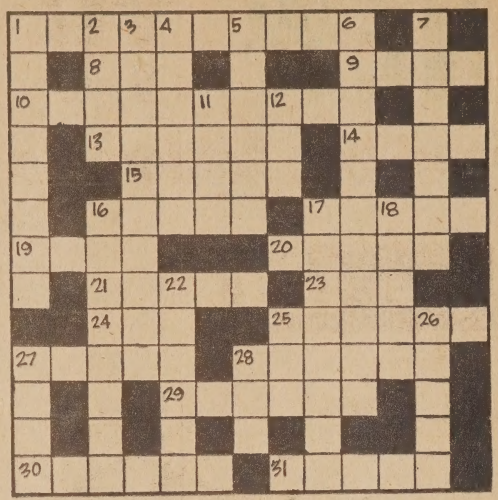
be superfluous to say that no expect a small player of this oduce hi-fi results, no matter rtisements in the daily papers m. Limited baffling gives an of bass rather than the real a certain amount of boxiness le. Some experiment with lin- case, and even extra bracing, much to improve matters, but ul whether you'll do more than d that such a simple thing can well.

is any choice in pickup cart- n one with average output and curve is better than one with put and a pronounced peak.



month's solution

THE R., T.V. & H. CROSSWORD No. 46



ACROSS

1. Actress' surname
8. Atmosphere
9. Metal
10. Valve element
13. City in ancient Greece
14. Engrave
15. An assault
16. A snake
17. Young bullock
19. Assert with confidence
20. Attains
21. Part of a machine which revolves
23. Anything small
24. Friend in French
25. Devices for accepting wanted signals
27. Most common liquid
28. A poison
29. Antenna
30. To offer for acceptance
31. Weighty

DOWN

1. Remaining after part is taken
2. Strikes a gentle blow
3. Old term for circus
4. Message
5. To nourish, rear up
6. Quality of a Beam Antenna
7. Lights carried in the hand
11. Ancient language of the Irish Goidels
12. Sit—past tense
16. Act of exposing to the action of the air
17. To completely soak
18. To pass within
22. Volley of abuse
25. New Zealand bird
26. Electromagnetic switch
27. Unit of electric power
28. To weep

Solution and further crossword next month

HOW TO GET YOUR AMATEUR LICENCE

(Continued from page 75)

own, wait until you have had a few weeks' receiving practice before attempting to send.

Always see that you have practice in receiving Morse a little too fast for perfect copy. This is essential if you are to pick up speed. You should aim for a standard several words ahead of the required 14 per minute, for under examination stress the best of us do not always show our full capabilities.

If you make friends with another amateur, he will almost certainly help you out by sending to you on the key. Use a standard P.M.G. key, if possible, because you are sure to be examined on this type.

The Wireless Institute of Australia conducts A.O.C.P. classes, and if you live near enough to attend, they offer excellent assistance to prospective amateurs. Not only is the formal instruction available, but there is opportunity for discussion with others studying for the same examination.

In order to give you a more definite idea of the standard required, here is the A.O.C.P. examination paper which was given to candidates at the October, 1958, examination.

Look through the questions and see how many questions you could answer correctly.

Next month we will supply a set of answers which we would have given if we had taken the examination. This should allow you to check on your answers and estimate how many marks you would have given to us.

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ANSWERS TO CORRESPONDENTS

A.B. (Croydon, Vic.) is 15 years of age and starting out with radio as a hobby. He has been able to make a good job of a crystal set, but finds it difficult to make the wiring neat in the case of some one and two valve sets he has tried.

A.: Most of us have gone through a similar stage, A.B., and no doubt with a little more practice you will be able to make a set as neat as the next one's. Study the wiring diagrams and underneath photographs of the various sets in the magazine and see if you can make your wiring look similar. When you get more experience you will know which leads you can tie into cables and which connections are best made direct from point to point. If you care to write to us again, through the 2/ query service, we would be happy to send you a circuit of a small set you could try. Mention the valves you have, and possibly we will be able to find a circuit to suit. Alternatively, some years ago we designed a series of receivers, using 1K5 valves, which are available cheaply from disposals dealers. You can start with a one-valve receiver and add a stage at a time as funds permit.

H.V.S. (Essendon, Vic.) has a dual wave radiogram, tuning between 13 and 42 metres. He is wondering if it would be worth the effort of erecting a proper aerial. He also asks about very high frequencies and frequencies lower than the broadcast band.

A.: A dual-wave radiogram with an RF stage and in reasonably good order should be capable of receiving most of the overseas stations which are of sufficient strength to be worth hearing. It can't compete with a specialised communication type receiver, which may be able to sort out very weak stations with interfering signals on adjacent frequencies, but there are plenty of strong signals with little interference coming into this country from all parts of the world. It is not an easy matter to design a high efficiency aerial to operate over a wide range of frequencies, and your best solution would probably be to erect an ordinary horizontal wire as high as possible and up to about 50ft long. Bring the lead-in down by the most direct route and use insulated wire where it comes into the building. The chassis of the receiver should be earthed. Since this does not involve a special balanced transmission line, the ordinary aerial and earth terminals on your receiver may be used. We can best answer your query about what you are likely to receive by referring you to the shortwave notes in recent issues. Then, there are the amateur stations, which should be receivable at 15 and 20 metres and possibly 40 metres, if this fits into the tuning range of your set. There is plenty of activity on wave-lengths shorter than those tuned by your receiver. The television signals, for example, all appear at wave-lengths less than five metres and there are many special communication channels, amateur bands, etc. There are at least two reasons why ordinary receivers do not tune these shorter wave-lengths. Apart from the television and FM channels, the transmissions are not of general interest, and special expensive receiver techniques are required to obtain good performance. Simple receivers do serve for wave-lengths longer than the broadcast band, but since most of the transmissions are coded messages between ships and aircraft, they are not of interest to the casual listener.

S.K.G. (Singapore, Malaya) writes that he has been a regular reader since seeing "Radio, Television and Hobbies" in a local bookshop in 1956. However, he feels now that we have been concentrating on television, to the neglect of audio and other subjects. He also asks about an amplifier circuit he encloses.

A.: Thank you for your comments and suggestions. Far from being put out by suggestions from readers, we welcome them, because they give us an indication of what readers require. Circuits and other information relating to most of our earlier amplifiers are available through the 2/ query service (details set out on this page), and we would be glad to help if you could give us a general idea of what you require. We can't undertake to analyse your amplifier circuit in detail, but a quick check suggests that all is in order except for the grid circuits of the 6V6-GT output valves, where the grid return resistors from the junction of the .05 uF capacitors and the 1000 ohm resistors to ground appear to have been omitted. A suitable value would be 0.5 megohm, ½ watt. However, the omission was probably only in drawing the circuit.

D.L.H. (Prospect, S.A.) has done some experimenting with transistor receivers, and forwards the circuit of a three-transistor regenerative receiver which he feels may be of interest for the "Reader Built It Page."

A.: Many thanks for your letter and we note the information on the receiver with interest. It is quite possible that we will find space to include it in a future issue. Our main criticism is that you do not include DC stabilisation in the audio stages, and the performance of the receiver may not be good at higher temperatures.

D.C.J.G. (Adelaide, S.A.) forwards a clipping from a local newspaper containing a "howler," apparently the result of lack of familiarity with technical matters on the part of a reporter.

A.: Thanks for letting us in on the joke. It happens in the best-run newspapers, so we won't laugh too loudly.

WANTED TO BUY, SELL OR EXCHAN

FOR SALE: Radio repairs neon sign £15 or offer. Also many new radio parts and testing equipment cheap. **Sydney UM8662.**

SELL: Advance E2 signal generator 100kcs 100 megs and attenuator, as new £30. Taylor's windsor test meter model 170A, ranges: amps 0.0002-10, volts 0-1-1000, dams 0.5-1000 megs volts ac/rf 0.1-250, £25. Technicorda tape-recorder complete, with mic, 2 stands and 10 good 1200 tapes, faultless £100. Power X'fmr, 600-0-600v 0.25A, 6.3v 5.0A c/t 5.0v, 30a c/t £5. Also coils, chokes, X'fmrs, condensers, resistors, tubes, switches, plugs, sockets and gangs. Phone JF5 23 **Simpson, 27 Portview Rd., Greenwich, Sydney.**

FOR SALE: Back copies of R. and H. 20s copies, April 1939 to July 1957 £10 or offer. Also valve tester, modulator, coil winder, speakers, large quantity radio parts offer wanted. **119 Barkly St., St. Kilda, Melb.**

SELL: Wire recorder Pyrox. Low impedence fully reconditioned with Hi-Fi speaker Box £55. **WF8815 Melbourne.**

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FOR SALE: Back Nos. R and H. for sale. April, 1939 to Oct., 1956. 2/- posted. Nov., 1956 to current copies 3/- posted, quote on large lots, also will buy spare R. and H. you have. If out of stock, I will get it for you. **A. J. Cox, 13 Glover St., Belmont, N.S.W.**

FOR SALE: 16mm sound projector "Micron" ten months home use guarantee trouble free must sell complete with glass beaded screen spare lamps and spools. Price £253 or offer. **T. Loricio, 50 Murray St., Colac, Vic.**

SELL: University T.S.T. super tester good order £25. Advance R.F. sig. gen. 100 kc/s to 100 mc/s new condition £32 also large quantity valves, and parts. **G. T. O'Brien, Mary St., Warwick.**

SELL: Advance E2 Sig. Gen., University AST Sig. Tracer; Taylor 45C valve tester; Fitted bench, small stock, many extras. Best offer. **1 Hill Street, Elizabeth South, S.A.**

SELL: ACOS HGP37 crystal cartridge. Diamond LP stylus Rola 120X loudspeaker. Both gntd. new. Offers? **Ron Suthern, Berridale 4.S. N.S.W.**

SELL: Palec valve tester A.W.A. service o.s.c. £30 or exchange for Wharfdale Woofer or offer. **XB1069 Melbourne.**

FOR SALE: Tape deck kit, new, fully machined. two speeds, double track, fast, F and R. high imped. full instructions, diagrams, £30. **JB2461. Mail, Hocking, 28 Best Street, Lane Cove.**

SELL: Zephyr 40RD mic. as new £15/10/. Royce Jnr. Traverse Gear (S. and Micro lead screws), VG cond. £6 Johnson, Box 166. **Frankston, Vic. (phone 1765).**

WANTED: Wide range speaker. **J. Neglins, 14a Bland St., Ashfield.**

SALE: New A.W.A.-7 band coil uni to 23 MC £7/10/- or exch. No. less valves. **G. Simpson, Degance St., worth.**

SELL: National H.R.O. receiver stages, crystal filter S. meter speake five sets coils, etc Will take £55 w **K. Warren, Walwa, Vic.**

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